

The American Midland Naturalist

PUBLISHED BI-MONTHLY BY THE UNIVERSITY
OF NOTRE DAME, NOTRE DAME, INDIANA.

VOL. II.

MAY, 1912.

NO. 9.

II.—OUR AMPHIBIOUS PERSICARIAS.

BY J. A. NIEUWLAND.

In regard to the plants known as Amphibious Persicarias, Smartweeds, or Knotweeds, and especially as to the specific delimitations of them as a group, various opinions have at one time or another been suggested, but only one or two have prevailed in our modern manuals or floras. The older Gray's manuals as also the manuals emanating from the New York Botanical Garden, such as Britton's, and Small's, recognize three species of these plants for the United States, *P. amphibium* Linn., *P. emersum* Michx., or *P. Muhlenbergii* Wats., and *P. Hartwrightii*. The new so-called Gray's Manual, seventh edition of Fernald and Robinson, relegated the last-mentioned species to the rank of a variety, as some one has told me 'because Massart had shown that *P. amphibium* changed into *P. Hartwrightii* when grown out of water.' The absurdity of such a reason I have already pointed out in another place.*

The very proposition of change refutes itself, and the person affirming it manifests botanical superficiality, and innocence, by failing to see the meaning of *Polygonum amphibium* Linn., failing to perceive that Linnaeus knew in Europe a Persicaria which existed in two phases one a floating-leaved aquatic, the other phase quite terrestrial, that he called the two phases one species, not even designating the forms and varieties, which of course, they are not; forms, or rather phases or even different parts often of the same individual plant!

This double existence of the species has as I have pointed

* AM. MIDLAND NATURALIST, vol. ii, pp. 2 and 3.

out been known in Europe for centuries. Linnaeus knew of the fact, and was sure of it—possibly by his own observation—when he called the plant *amphibium*.

As to *P. Hartwrightii*, A. Gray, who recognized it as a separate species, doubtless knew of the plant in both an aquatic and a terrestrial phase, or if he did not know it in the former he certainly knew it to be different from any corresponding phases of any plants known up to his time. Had any novice or amateur written to him that *P. amphibium* changed to *P. Hartwrightii*, he would have at once perceived in it the mere guess of some blundering tyro, ignorant of the fact that more than one species is dimorphic, or even polymorphic, and incompetent to distinguish two species by their respective descriptions.

An opinion regarding the status of the amphibious *Persicarias* different from those of the New England as well as the New York botanists is that of Dr. E. L. Greene, who first took up the logical segregation of these plants. The groups into which they fell under his treatment may be designated as the *Hartwrightianae*, the *Emersae*, and the *Amphibiae*. The last I should prefer to omit and distribute its members between the other two.

Dr. Greene maintains that a number of valid species have been overlooked hitherto, or referred to the three above mentioned species. On the basis of specific distinctions usually in vogue among botanists at present for other plants as a standard, one can hardly hesitate in agreeing with him. True, the same standards for segregation can not always be applied to all plants indiscriminately, still it is inconsistent and illogical to neglect principles of differentiation in one case and apply them in another when the cases themselves are undoubtedly similar. Dr. Greene has besides devoted to this class of plants more study, particularly in the field where alone they can be scientifically known, than any other American botanist. His conclusions regarding them therefore ought at least to be considered with some regard rather than with the total indifference of botanists generally. As I have already shown he is the first of our modern phytographers to describe and insist on describing these polymorphic plants with different paragraphs for the phases which are as different as if they were actually distinct plants. Such, as he says, is the only logical or intelligent method of treating them with any hope of recognition. Of course such a system does not, or for a while

perhaps, will not meet with favor among manual makers whose patterns of description are hide-bound, and whose volumes are made to cover an impossible area of the country, and rather to reimburse financially than to give adequate information. There will undoubtedly come a time when students will reason that a little accurate knowledge is worth more than volumes of superficiality, when local floras will be more in demand than territorial ones; but for the present, what with the ignorance of the student and the prejudices or even ignorance of manual makers, descriptions under several captions of many polymorphic plants will continue to be a decided financial disadvantage, and so a more or less complete knowledge of the amphibious smartweeds will continue to be the heritage of a few. It has in fact come to such a pass that even otherwise reputable botanists label for the herbaria anything as *P. amphibium* L. that has floating glabrous foliage. Any *Persicaria* that has spreading borders to its ochrea is called *P. Hartwrightii*, and any plant that has neither of the above characters is necessarily *P. emersum*! And for that matter these are about all the characters worth mentioning that the average manual considers sufficiently distinctive. This fact is accounted for, because the average student of taxonomy does not for too long a time consider that there is anything worth knowing about plants not in a manual. We can not put any reliance on names of amphibious smartweeds labelled even by renowned botanists, because the plants being collected in one phase only, are at most but fragmentary, and the manual-learned information that impels the labelling, is still more so. When therefore, as occasionally happens, a collector stumbles on a riparian specimen with both terrestrial and aquatic foliage on one shoot, in other words, contains all the above mentioned different and supposedly distinctive characters of the three species referred to, then arises the dilemma as to whether the plant is to be called *P. amphibium*, *P. emersum* or *P. Hartwrightii*. No matter how ignorant the student or unsophisticated in things botanical he has usually enough common sense to know that two species could not grow in the same shoot no matter how different in appearance, and usually, unless he leaves his specimens unnamed and unlabelled, comes to one of two conclusions; either the manual makers are sometimes possessed of but average ig-

norance on some things, or he decides to study plants from nature's volume rather than from one of man's making.

Beside the taxonomic views of the amphibious smartweeds referred to, that of Linnaeus himself is not to be overlooked here. It was prevalent until the beginning of the nineteenth century without even being challenged in any detail. Linnaeus recognized but one species which he called *Polygonum amphibium*. The reason I refer to his view is that as a result of field work for a number of years back, as also because of investigation of some thousands of specimens, I have come to the conclusions, that, whatever premises have been taken up by our systematists as to the idea of delimitation of species of Water Persicarias, there is no logical position between that of Dr. Greene's on the one hand and that of Linnaeus of the other extreme. In other words we may hold with the latter that there is but one species of Water Persicaria, or with the former that all the evidently different plants are distinct, but the *via media* of supposing that some are valid and others not, as held by our manualists, is positively untenable from a logical point of view. Either all must be accepted for they have absolutely the same reasons for acceptance or rejection, or none need be received. In the latter instance they will probably, if any show of consistency is used, be relegated to the status of "varieties" or "subspecies," of *P. amphibium* Linn.

In this connection I may say that in studying the plants, I have not confined myself to herbarium material which in the case of such variable plants as those in question, can be of little or no value whatever, not only in delimitation of the species, unless properly collected, but even in actually determining the identity of isolated specimens. In field study I have not confined my attention to any one specimen which on careful examination could be more or less arbitrarily considered as an average type, but have whenever possible gathered all available varying forms of a specimen to be found in a colony or locality. In this way I have at times collected as many as 50 to 100 samples of a specimen all of which I was sure were not only one species, but which I was fairly sure came from one original rootstock. This was done that no variation of form or phase might possibly escape me of the transitions from aquatic, riparian, terrestrial, to xerophytic flowering or sterile plants. I have not, moreover, considered it sufficient to study any given plant at one time; for example, the flowering or fruiting

period, but on once locating a good colony of *Persicarias* I have sought as often as possible during the various seasons to visit the place to note the seasonal variations from spring until late in fall, and have found these changes in appearance to be often quite remarkable. I have in fact, for some years past had the field study of the amphibious smartweeds as one of my principal aims in botanizing in various places in the east, middle west and even far west, and I have become more and more convinced that it presents problems that only the local field botanists will be able to solve.

Between the views of Dr. Greene who maintains that there are a considerable number of amphibious *Persicarias* and Linnaeus who at his time had but one, I have stated that no logical opinion could be maintained. Dr. Greene has segregated a number of species from what was, for the sake of concealing ignorance, called *P. amphibium* Linn. Regarding the suppression of *P. Hartwrightii* as a species in Robinson and Fernald's Manual, I may here add to what I have already maintained concerning this species, that logical consistency would demand the suppression of *P. emersum* as well. Dr. Greene has first described the aquatic phase of the latter, and I have since found excellent examples of it at Luray, Virginia in 1910, and with the aid of any of the above mentioned manuals it is absolutely impossible to determine this aquatic phase of *P. coccineum* or *P. emersum* as anything, but *P. amphibium*, in the common sense of the word, as understood by our American botanists. It is a glabrous submerged plant with slimy floating foliage, leaves subcordate or rounded, and in the aquatic, as well as some narrow leaved forms of the summer terrestrial, superficially quite indistinguishable by me from *P. mesochora* Greene. Yet the last named plant in its terrestrial spring and sterile phase could not by the merest amateur be confounded for either what is called *P. amphibia*, or, especially from any form is *P. emersa* I have ever seen; for the last never has even the slightest trace of herbaceous achrea borders so characteristic of *P. Hartwrightii*, whereas *P. mesochora* has these very markedly and always in the spring terrestrial phase.

Moreover, regarding the plant which I found at Luray in the Shenandoah River, as *P. coccinea* or *P. emersa*, I also found growing with it on the shore the various stages of riparian and terrestrial phases of the colony, all on one rootstock, the former in mud and

the latter upon the drier bank close by! Had I not found all these indubitably connected I should not have hesitated for a moment in calling the aquatic phase *P. mesochora*. This is but another instance to show how futile it is to gather or study these plants without obtaining all the phases, and being positively sure of their connection, and selecting all the variable specimens that exhibit notable differences even in one colony. Nay more, in spite of the remarkable resemblance of the aquatic phases of *P. mesochora*, and *P. coccinea* it is to be remembered that no two members of the group could be more different from one another, except perhaps typical *P. Hartwrightii* itself. Now as *P. mesochora* possesses the herbaceous spreading tips of the ochrea and narrow leaves in its sterile terrestrial and spring plants so characteristic of *P. Hartwrightii*, one can readily see that such characters though quite valid as distinctions, are to be used only when one is perfectly sure of the phases of the plants in which they are found. By virtue of the character above mentioned *P. mesochora* belongs to the *Hartwrightianae* as a group. It does not therefore belong to the same group as *P. coccinea*, nor has any very close relationship to it; for the latter never in any of its phases, terrestrial, aquatic, or even spring sterile terrestrial, has been found to have spreading herbaceous borders to the ochreae.

Not only does *P. coccinea* resemble *P. mesochora* in the aquatic so closely as to be difficult to distinguish, but I have found at times among the ordinary broad leaved blooming terrestrial phases of the former, plants in flower with the narrower leaves of *P. mesochora* as the latter grows typically in the terrestrial phase. Such plants I have collected on the Virginia shore of the Potomac River at Plummer's Island, growing as aberrant forms of *P. coccinea*, most of the plants being typical wide-leaved specimens of the latter. I must confess my inability to distinguish these aberrant forms from typical plants of flowering *P. mesochora*, as I have collected this at the lakes at Notre Dame, Ind., and described elsewhere as types of the terrestrial phase of the latter. And yet it is to be remembered that the spring plants of these two species could not possibly be confounded even in herbarium specimens. It is to be remembered, moreover, that typical *P. coccinea* or *P. emersa* in phases indubitably proved to belong to it, is practically indistinguishable from *P. amphibia* as the manuals understand the latter. It is to be remembered also that the real

P. Hartwrightii A. Gray. never except in some subaquatic or riparian phases actually at any season is devoid of the characteristic spreading borders of its ochreae, and when these are absent the short inflorescence and characteristic glabrous long narrow leaves make it unmistakable. If after remembering all these facts concerning the resemblance of *P. amphibia* and *P. emersa*, as also the great differences between the former and *P. Hartwrightii*, we consider that the manual makers have suppressed the specific status of the last and retained that of *P. emersa*, then indeed we are justly entitled to wonder by what standards of taxonomy such things are done! This too in face of the fact that the aquatic phase of *P. emersa* was described and well known by some who took the trouble to investigate.

The very characterization of plants as "varieties" which have over and over again been shown to grow on one plant, as is done by the manuals, leads us to infer that either the authors have a new meaning for the word, or they know not the plants which they are trying to describe. What then is it that makes *P. emersa* a valid species, and *P. Hartwrightii* only a variety? The only characters worth while mentioning are the broad leaves of the former, its longer inflorescence, crimson flowers. All the others, as well as these in fact, vary in the plants so much that I can show plants and phases of them that may be referred to any and all of the descriptions as found in the New Gray's Manual, for *P. Muhlenbergii*, *P. amphibia* or *P. amphibia* "var" (?) (!) *Hartwrightii*. (Gray) Bissel, and yet the specimens grew on one root-stock! If then the difference between *P. amphibia* and *P. Hartwrightii* is insufficient to merit, in the minds of the manual writers, a valid specific standing for the latter, how then is it that with no greater reasons for the validity of *P. emersa* as a species, the latter is retained? Reasons or show of reason if any exist I have never been able to find. It follows then that if *P. Hartwrightii* is to be rejected then *P. emersa* must be reduced to synonymy, or made a "variety." If the two are both valid then Dr. Greene's, and Sheldon's segregates having equal or greater reason for specific standing, must also be accepted.

There can be no "half way" between accepting all, or rejecting all, where all individually have the same or equal reasons for recognition. We must, therefore logically accept either Dr. Greene's position in the matter of the status of the amphibious smartweeds,

or be forced back to the original Linnaean idea of but one species.

Whatever reasons the authors of the seventh edition of Gray's Manual had for relegating *P. Hartwrightii* to the status of variety, Dr. Cowles* still maintains that it is the same as *Polygonum amphibium*, or only a "hairy form" of the latter. From the brief references given to the two plants, one would infer that he is insufficiently acquainted with the plants to know what they really are. In fact *P. Hartwrightii* as Dr. Greene had shown, is by no means a plant "with leaves covered with numerous and stiff long hairs." *As a terrestrial phase or "form" it is quite smooth, and never has hirsute leaves even as a "land form."* Dr. Cowles also seems to infer that the aquatic phase is the "typical" phase of the plant. If it is meant that Linnaeus published this either without reference to terrestrial or knowledge thereof, the information is beside the point. From the description and drawing of the terrestrial "*Polygonum Hartwrightii*," whatever that name means to the author, I would infer that he does not know what the real *P. Hartwrightii* Gray is, for he actually described what Dr. Greene published as *P. ammophila*. Moreover, *P. ammophila* and *P. Hartwrightii* are as different from each other as *P. amphibia* is from *P. emersa*. Moreover, one remarkable fact, among others as important and more so about the real *P. amphibia*, is that its terrestrial phase known for centuries in Europe *has not spreading borders to its ochreae!* There is in fact no plant in Europe that has these, and just because the terrestrial of Europe and the various terrestrial plants of America which in no way resemble one another happen to have aquatic phases more or less as distinct as such, there is no conclusive reason for saying that *P. Hartwrightii* has been changed into *P. amphibium*. There may be a certain amount of mental amusement in juggling names, but for all that, it is the duty of the ecologist to see that they are applied to the proper things. "*Nomina si nescis perit et cognitio rerum,*" is a very old adage. There may be little in a name, but unless we are sure what is represented by it, the knowledge of phenomena and things may become a hopeless mess. Presumably Dr. Cowles does not believe in the numerous species of *Persicarias* as outlined in the last few years, and if he does not accept even *P. emersum*, shown to have an aquatic phase more like the real *P. amphibium* of which it may be called a broad-

* Cowles, H. C. Textbook of Botany. Vol. II. Ecology. pp. 574, 575.

leaved long-spiked congener, then, he is at least more logical than the writers of any of the manuals. I think, however, that there will be few taxonomists who will agree to this, so strongly has the specific standing of *P. emersa* obtained a hold. On the basis of suppressing all the amphibious persicarias but *P. amphibia*, the author ought to be consistent, suppress other specific terminations which are used in the work and have as little or less reason for recognition.

In order to show how one would fare in the study of the amphibious persicarias with the help of the manuals we may suppose for example that a student taking either the New York or the New England manuals to determine the plants already referred to, viz: the one found at Luray, Va., the other at the Notre Dame Lakes. In regard to the former with the aid of both or either Britton's or the new Gray's manual, the student would find that the former is a plant that the books call *P. amphibium* Linn., when floating in water, whereas branches on the same shoot higher up on the shore are typical *P. Muhlenbergii* Wats., or *P. emersum* Michx. When the student finds what the manuals call two separate species, on the same rootstock, to his mind comes the query: "How can one end of the plant be called one of these species and the other end an equally well recognized species?"

Let us suppose, moreover, that the same student later finds in the Middle West a plant, which in early summer or spring, when not yet blooming, has the spreading herbaceous ochrea margins of what Gray's New Manual calls *P. amphibium* Linn. var. *Hartwrightii* (A. Gray) Bissel, or which Britton's manual calls *P. Hartwrightii* A. Gray. The same student watches the plants carefully until late in summer and autumn, and finds that the spreading herbaceous margins gradually disappear so completely, that at flowering time one part of the plant growing on land near the water resembles narrow leaved forms of typical *P. emersum* according to the books, as it grows along the Potomac River for example, whereas another part of this same western plant taking to water becomes a floating glabrous slimy aquatic that finds no description in the manuals save that for *P. amphibium* Linn. These water shoots have no longer "leaves lanceolate to ovate acuminate, and peduncle hispid often glandular." on which one of these manuals puts so much stress, but now in water have "obtuse or acutish leaves" and "peduncles glabrous, spike terminal, dense ovoid or

short cylindric" of the *P. amphibium* description. The only obvious conclusions the student is led to are that the manual makers have either not described what might be separate species by their proper distinguishing characters, or, that they did not know the plants they attempted to describe, and that this want of knowledge came from the fact that study in herbarium of isolated separate aquatic and terrestrial phases not known to be physically connected, led to erroneous conclusions, and that separate names were applied to apparently separate plants that in reality were one. Further investigation on the part of the student reveals other facts. First of these is that there are amphibious persicarias which are easily distinguishable from others in not having in spring or at any other time, spreading borders to the ochreae whereas others always have them, and others again lose them at blooming time. Here plainly are three easily distinguishable groups provided the complete set of seasonal phases are present.

The student may notice too that some plants that have nearly the same shape of aquatic foliage never bloom except in different phases, or that their terrestrial phases growing under exactly similar conditions, often in the same place, are notably or unmistakeably different. The aquatic, for instance, of one of these never grows or blossoms except in deep water, whereas the other plant is normally terrestrial in flowering phases, never blooming except out of water and on shoots with terrestrial foliage, and always clinging to the shore, and only producing a few aquatic leaves early in the season or when raising themselves from shallow water near shores.

These observations could force the student only to the following conclusions. Either the manuals because of their attempt to compromise are inconsistent, and we must go back to the Linnaean idea of one species of amphibious Persicaria, or we must accept a large number, with different standards of delimitation of the species than those found in these common manuals. Either view may be logical in itself and depends on the premises assumed as to the characters that distinguish species. The latter course is more reasonable if we weigh carefully or compare sedulously our idea of species as applied to other plants nowadays accepted by the manuals and floras. The *via media*, however, which consists of admitting one or two species besides *P. amphibia*, that is also *P. Hartwrightii* and *P. emersa*, or either of these

without the other, is hopelessly illogical on the basis of characters as they are outlined in our books. Neither of these plants have by virtue of their descriptions in all our common books any better reason for existence or acceptance, than any of the number published by Dr. Greene, and most of his have been based on more solid distinctions than those of these two plants. Admitting for example as we must, that *P. emersa* Michx. has an aquatic phase that the manuals can not distinguish from *P. amphibium* Linn., then there is nothing left of all the descriptions of all the manuals, except that the former is *usually* broader-leaved and *usually* longer spiked *P. amphibium*. *P. Hartwrightii* is for similar reasons but a *P. amphibium* with spreading borders to the ochrea.

The ecology of the amphibious persicarias is to be taken into consideration in their classification. When we force certain plants into abnormal habitats producing peculiar individuals these changed "forms" are in no way to be considered as new species or for that matter even as "varieties." Plants, however, naturally choose their own habitats or at least adapt themselves to them. If we find in one locality a plant like *P. fluitans* which takes always to deep water,—and another like *P. ammophila* which though early in the season possesses leaves like those of *P. fluitans*, but, unlike it, can not be made to bloom except in the terrestrial phase when the aquatic part of the plant has almost disappeared, and which will never bloom except out of water, and if this character is found to be constant, then we are justified in saying that the plants are not the same. It may be said that they are but two "forms" that have adapted themselves to different habitats. It is to be remembered that these habitats are not only near one another but actually continuous or contiguous. Seasonal drought and freshet changes may have brought about an inherent disposition to take to one prevailing habitat or other, and this tendency may have been inherited in succeeding generations. At all events the finding of a specimen of *P. ammophila* with shoots blooming in the aquatic phase or, vice versa, of a blooming shoot of terrestrial *P. fluitans* would sufficiently establish the identity of the two species. Such have not as yet been found and I therefore prefer to regard them as separate species until their identity has been proved.

That there is a factor to be explained by ecologists beside the mere differences in the above-mentioned plants, *i. e.*, *P.*

ammophila and *P. fluitans*, is evident from the following. I have found the former most abundant at Millers, Ind. in pools which seem never to dry up quite completely. If there were but a matter of selective habitat to explain their identity, why would not *P. ammophila* venture out a few meters into deep water and bloom as an aquatic, rather than hug the shore and wait until the aquatic foliage is withered on account of drying up of the water, before it blooms solely as a normal terrestrial. In other words the habitat of *P. fluitans* is present where *P. ammophila* invariably grows! *P. fluitans* is reported from Dune Park, but a few miles away.

I have found it difficult in course of a number of experiments to force terrestrial phases to change to aquatic. The plants are invariably so shocked by the sudden change to water that they die. I have however succeeded in keeping *P. ammophila* in aquatic phases growing as such, without blooming of course, for many months. I have one such shoot that kept a few aquatic leaves all winter in a twenty gallon glass jar with some soil in the bottom, and that too in spite of the ravages of *Oscillatoria* that would have choked any other plant, as it actually did all the *Myriophyllum* shoots and *Utricularia*, as also in spite of water-snails that seem carefully to avoid touching the foliage of the smartweed for some reason or other.

Though some forms of *P. grandifolia* and *P. pratincola* are quite indistinguishable at times, the aquatic phases could hardly be confused. Similarly *P. rigidula* in the same phase could not be mistaken for either, by the shape of its leaves. This plant has, however, a very characteristic pubescence in the terrestrial phase. Superficial observers in studying these plants sometimes overlook the fact that two different species growing close together may have shoots one as hairy as the other, yet the *character* or *kind* of pubescence may be totally different and usually not noticeably so without a hand lens.

The fact that in some of the species of amphibious persicaria the aquatic phase is to all appearance, simply vestigial, found only early in the season, and only for a short time, never to be looked for at flowering period, shows that they are normally adopting a certain phase exclusively. How long ago this process of divergence of types was begun it is impossible to say. Students of phylogenesis would say, that as these developments seem to be

taking place at the present time, this group of plants ought now to be a subject of very interesting study. Some of the species are still normally amphibious in the true sense of the word, and able to pass rather quickly from one habitat to the other. In fact some, like *P. mesochora* and *P. coccinea*, may have the characteristic terrestrial and aquatic shoots on one rootstock. Others may have the characteristic foliage of both phases even on one shoot, the upper terrestrial and lower aquatic, as in *P. ammophila* and especially *P. grandifolia*. In others as *P. pratincola* or *P. fluitans* one or other of the phases may be either completely obliterated or vestigial.

Whether the law of mutation is a notable factor, will, it seems to me, be a rather difficult problem to ascertain, for seeds of Persicarias I have found hard to germinate successfully. Some attempts made have been without avail. I have not in fact, as yet found a single indubitable seedling of any member of the group, possibly because it may be difficult to distinguish any given plant from other water persicarias, such as *P. Hydro-piper* and *P. hydropiperoides*. Moreover, the difficulty of forcing normal terrestrial phases of plants known to be normally also aquatic, into the latter phase, offers difficulties directly proportionate to the periods of time they were allowed to grow in one habitat exclusively without access to the other. In other words shoots of *P. mesochora* for example will only bloom simultaneously in both phases at the water's edge. A plant too long kept from water and grown on dry soil exclusively, will even lose its power of blooming as a riparian plant, and take on what may be considered as a sterile xerophytic phase, the pubescence of which in this case resembles that of a plant found by me at Studebaker's woods and hereafter to be described as new. This pubescence of the xerophyte of *P. mesochora* lasts only during the early season and the plant later becomes glabrate like typical terrestrial plants of the above-mentioned species. Shoots of the new plant to be hitherto described retain such pubescence always, and even, on the contrary, become more so later in the season.

As Dr. Greene has pointed out, the amphibious smartweeds have every one, at least potentially, several separate phases, and must be studied and described in their separate phases. As long as the manuals persist in describing only in part plants, which though resembling one another in one phase, are different essentially

in others, we can hope for nothing but hopeless confusion and ignorance. The examples quoted have, I think, sufficiently shown this. The authors who will not admit the system must perforce logically go back to the Linnaean one species, *P. amphibium*, for on the basis of classification as now obtains in the manuals, *P. emersa* is as untenable as *P. Hartwrightii*. Admitting these two, we must also logically admit Dr. Greene's species.

Moreover admitting these two plants as separate species, and logically also the others, one is also as logically led to the conclusion that there is no typical *P. amphibia* in America. The terrestrial phase of this has been many times described by European authors and lately again by Massart.* The only plants that could be mistaken for it are *P. mesochora* forms, and specimens of *P. fluitans*. The former has spreading herbaceous borders to its ochrea in the terrestrial phase, as have many others such as *P. Hartwrightii*, and *P. ammophila* which in aquatic form are somewhat like the European plant. *P. fluitans* has no known terrestrial form. *P. amphibia* of Europe never has these spreading margins in any phase whatever. *P. emersa* in its aquatic phase may be considered like *P. amphibia*, as I have pointed out, but to say that they are the same is equal to suppressing one of them. Moreover, there is no narrow-leaved terrestrial phase growing in America that sufficiently resembles that of the *P. amphibia* in Europe, that could possibly serve as a terrestrial phase to prove the existence of the real aquatic here. In other words as there is in America no terrestrial phase like that of the European *P. amphibia*, therefore, if the latter exists here it exists without a corresponding terrestrial, none being like it here, and this fact alone renders its presence here, at least highly improbable. The absence of a terrestrial presupposes the absence of the aquatic, and the aquatics we have are phases of one of the other *Persicarias* whose terrestrial phases differ from any European terrestrial plant.

As few if any collectors in the past, or apparently at present, gather all the different variations or phases of these plants, or make any pretence to establish the relationship or identity of aquatic and terrestrial specimens from any given locality, the determination is a difficult matter and sometimes quite impossible. Such ignorance of other plants would be considered intolerable

* Massart, J. C. L'Accommodation Individuelle Chez *Polygonum amphibium* Bull. Jard. Bot. Vol. I Fasc. 2, 1902.

among even amateur students of nature. There can be no more apt analogy of such careless classification of plants unless it be that of the older biologists who called caterpillars and any elongated crawling things worms. There has come a time long since that the amphibious smartweeds must be distinguished on a totally different basis from heretofore, and despite the reiterated assertions of Dr. Greene, that when plants are heteromorphic they need separate diagnosis for every phase, we wonder that antediluvian systems of distinguishing these plants still maintain. That the manual makers should not have known these facts long ago, is beyond comprehension, unless as one suspects, they prefer to follow the easy path of hidebound ignorance.

I shall now add a few new descriptions of phases of the amphibious Persicarias which have been discovered since the last discussion of these plants. Several new varieties or species are added, together with a list of the various hitherto known species as I have found them represented in the herbaria to which I have had access during the last year. It is hoped that though considerable space may be taken up, it may be useful to cite the proper specific names of specimens that have been called variously *P. amphibium*, *P. Hartwrightii*, or *P. emersum* by the collectors. Foremost of these herbaria to which I have had access are the U. S. National Herbarium at Washington, where I have spent the larger part of two summer vacations mostly studying these plants. I have also all too briefly examined those in the New York Botanical Garden. Dr. C. C. Deam has kindly sent me his collection for examination, and specimens have been sent me also by Dr. J. Lunell, and Rev. Z. L. Chandonnet from Minnesota. My own collection of these plants extended over a number of years in various parts of this country, especially the immediate vicinity of Notre Dame, Ind., within seventy miles in various directions, as also at Detroit and vicinity, in Oregon, Virginia, West Virginia, Maryland and the District of Columbia and other places.

Beside the two new phases to be described no notice at any length will be made of plants already known. Only diagnoses of hitherto unknown phases will be made. I have, as far as I have been able, tried to arrange the species in the order of natural relationship. Most of the plants of the Midland prairie region are included, none from the far West, and from the East only such are mentioned as are known also from our Region.

Genus *PERSICARIA* Tragus, (1531), in Brunfels' Herb. Viv. Icones. Brunfels App. p. 18 (1531), also Tragus do. p. 161 (1531), also *Pulicaria* Brunfels, (1531), etc., etc.

Persicaria Tournefort, (1694). Els. Bot., p. 410, (1700) Inst. Rei. Herb., p. 509, also Linn., (1737) Gen. Pl., p. 35. *Polygonum* Linn., (1754) Gen. Pl., p. 170. in part; also Sp. Pl. p. 359 in part.

Persicaria Trew in Herb. Black., (1754), Tab. 118 and 119, Hill, (1756) British Herball, p. 486, Shaw, (1757) Trav. and Obs. Lev., Collect. p. 466., Morandi, (1760) Hist. Pl. Pract. p. 118., Adanson, (1763), Fam. des Pl. vol. II., p. 276.

Section. POTAMOCALLIS.

Perennial plants typically amphibious with rose-colored to crimson flowers, (never white).

Subsection I., EMERSAE.

Plants never having spreading herbaceous borders to the ochreae in any of the phases.

PERSICARIA AMPHIBIA (Linn.) S. F. Gray, (1821) Nat. Arr. Br. Pl. vol. II., p. 208.*

Since the last time I made a study of the European species in the National Herbarium a larger number of specimens are now available. Though there is some variation in the plants both terrestrial and aquatic, I am more than ever persuaded that *P. amphibia* is not found in America. Whatever resemblance there may be in the aquatic phases to our well known plants either *P. canadensis* or *P. fluitans* or *P. mesochora* or even the aquatic plants that are to be referred to *P. coccinea*, there can be but one reason advanced for their identity with it, and that is at most a negative one. *P. mesochora* Greene, can at once be dismissed because in its spring terrestrial phase it has the spreading ochrea borders and wider lanceolate leaves of the terrestrial phase. *No European plant has as yet been found with these borders!* And yet *P. mesochora* seems in every way the nearest relative of our American plants to the real European *P. amphibia*, superficially observed.

P. fluitans Eaton and *P. canadensis* Greene have not it is true been found in their terrestrial phases. There seems much reason to suspect that they are normal aquatic without terrestrial phases, because of their deep water habit of growth. *Moreover, I have*

never either in the field or herbaria seen any terrestrial phase of an amphibious smartweed that was even a near approach in appearance to the distinctively narrow-leaved plant of Europe. I have in the field found some terrestrials with narrow leaves resembling those of *P. amphibia* and without the spreading herbaceous borders. but study of the spring and early summer terrestrials invariably showed the presence of these borders that later disappeared. I venture for this reason to predict that should the terrestrial phases of *P. fluitans* or *P. canadensis* be found some day they will have herbaceous borders to their ochreae! The reason for this suspicion, as I have just intimated, is obviously, because if the terrestrial phase actually exists, comparison with aquatic phases such as *P. ammophila* shows that terrestrials such as those of *P. asclepiadea* or *P. ammophila* itself are likely to be the forms. The latter has an aquatic phase that at times could hardly be distinguished from *P. fluitans*, but for the fact that it never blooms in the water phase.

The most notable examples of *P. amphibia* which I have studied are the following mostly from the U. S. National Herbarium.

No. 133941 U. S. Nat. Herb. Richter's gathered at Pesth, Hungary. Aquatic.

No. 257776 collected by the same is a riparian specimen.

No. 387898 by G. de Chalmot, Kampen, Holland. The leaves are subcordate and lanceolate rather than the usual oblong-elliptic leaved specimens.

No. 155279 collected by Mezambara (?) near Venice, also has subcordate leaves.

Nos. 133947 and 155398 on the same sheet, the former the terrestrial, the latter subaquatic or riparian, both from the herbarium of G. C. Joad, July-Aug. 1866. "Flora Ingrica." The terrestrial leaves subcordate 5-11.5 cm. long and 1-2 cm. wide, are scattered-strigose, some of the hairs gland-tipped, the leaves of the latter are 10-15 cm. long and 2.5-27 wide.

No. 155398, Aug. 2, 1861. Specimen by Thorion. (Place and other data illegible).

No. 45440, by S. E. Lassimone from France, Aug. 6, '92. The terrestrial plant is not typically terrestrial but somewhat intermediate. Aquatic leaves 12x3.5 cm. acute, subcordate. The terrestrial are much smaller 7x1.5 cm.

No. 133946 Ahlberg's, Aug. 1865, from Upland, Scandinavia. The plant is aquatic with a transitional terrestrial.

No. 45439. Mouillefarine, Tours. June 19, 1892. Aquatic.

No. 810258. A. Moller, June 1880, from Portugal. The leaves are very broad, 2.7-4 cm., and 9-11 cm. wide.

In the herbarium of the New York Botanical Garden we find the following:

Rydberg's. Aug. 1866. Skedbrack, Sweden. The leaves of this specimen resemble those of *P. mesochora* more than any specimen I have seen. Also Kindly's No. 26 from the herbarium of the Linnaean Society.

Carleton Curtis from Wicken Fen, Cambridge, Eng. Aug. 4, '96. The leaves are cordate at the base as also those of the preceding; both aquatic.

C. Reik's. Aug. 1875 from Aistershaim, Upper Austria. Terrestrial with strigulose appressed pubescence. The leaves are typically long and narrow.

No. 1264. July 30, 1827, collected near Vienna, has rather typical aquatic and terrestrial plants showing the charactersitic perfectly glabrous smaller leaves of the aquatic.

A specimen from Meisner's herbarium. Sept. 1828. Collected at Geneva is also a good example. In the Torrey Herbarium, Haworth's from England has leaves on the aquatic remarkably like those of *P. fluitans*, as also a typical terrestrial plant.

PERSICARIA COCCINEA (Muhl.) Greene, (1904). Leaflets I. 24 and 36.

Polygonum coccineum Muhl. (1809) in Willd. Enum. Hort. Berol. p. 428.

Probably (?) *Polygonum amphibium* var. *B. emersum* C. Richard in Michx., (1803). Flor. Bor. Am. I. 240.

Polygonum Muhlenbergii S. Wats. (1879). Proc. Am. Acad. XIV. p. 295.

Polygonum emersum (Michx.) Britton (1889). Trans. N. Y. Acad. Sc. VIII. p. 73.

Persicaria emersa (Michx.) Small (1903) Fl. S. E. U. S., p. 376.

Considering this species in the limited sense apart from the segregates recently made, the description of the terrestrial and

the riparian phases have been elsewhere given.* The aquatic phase has since been rediscovered by the writer at Luray, Va., on the shores of the Shenandoah River near Shortass Mountain, Sept. 6, 1910. Rather good specimens of riparian plants were growing on the shore connected by rootstocks to the floating aquatic plants. Another good specimen of riparian phase is in Mr. C. Deams' herbarium. The lower leaves are aquatic and the plant emerged from the water later so that the flowering spike was produced on an aerial shoot. The stem is really aquatic below and terrestrial above.

RIPARIAN PHASE. Lower leaves subaquatic, perfectly glabrous, abruptly short acuminate, rounded, truncate, or slightly subcordate at the base, 8.5-10 dm. long, and 2.5-3.5 cm. wide; petioles 2-4 cm. long, slender; upper emerged, 15-17 cm. long and 4-5 cm. wide with short petiole 1.5-2 cm. long; margins rough as is also the midribs of the lower surface of the upper leaves, otherwise perfectly glabrous; peduncles minutely glandular pubescent 9 cm. internodes 3-9 cm. long, leaves very thin.

A good example of the riparian plant is No. 697, collected at Luray, Sept. 6, 1919, and mounted on the same sheet as the typical aquatic phase. Mr. Deam's plant already referred to, and collected at Vanemon's Woods S. of Bluffton, Wells Co., Indiana, is strictly speaking to be considered as more aquatic since it has the lower leaves almost aquatic except for their more acute apex. The upper leaves are like those of the type. The spike is, however, very long about twice that of the eastern plant. The leaves have the appearance of those of *P. laurina* Greene, but are much broader.

AQUATIC PHASE.† Leaves perfectly glabrous, slimy and shining, all floating rounded to subcordate at the base, simply and abruptly acute at the apex, (sometimes obtuse) elliptic-oblong or ovate-oblong, perfectly green, 7-10 cm. long, 2-4 cm. wide; petiole 3-5.5 cm. long, slender; stems swollen between, and just above the nodes, rooting in the water; internodes slightly fistulous 4-6 cm. long; spike cylindric usually solitary 3-4 cm. long, flower small rose-colored to rose-red; bracts membranous somewhat green in the middle, acute to acuminate, glabrous, entire; peduncle shining glabrous with one or two large bracted flowers above the middle, where it becomes very slender.

* Greene, E. L. Leaflets, vol. i, p. 35; also AM. MID. NAT., vol. ii, p. 20.

† See also Greene, E. L. Leaflets, vol. i, pp. 106, 107.

The aquatic plant was found by me along the Shenandoah River near Luray. The aquatic phase is No. 697a, as referred to above, several of the plants on the same sheet with the riparian phase No. 697 were found with it.

Following are other good examples of *P. coccinea* which I have studied in the U. S. National Herbarium.

No. 444732. Collected in Huron Tp. Erie Co. Ohio, VIII, 18, 1892.

No. 672000. Webster Co., Iowa. XIII. 1, '09.

No. 672476. M. P. Somes, Webster Co., Iowa, VIII, 13, 1909.

From the New York Botanical Garden Herbarium I select the following:

[Thomas Morong's Rockland Lake, N. Y. VIII, 26, 1891.]

This is probably an aquatic phase of *P. coccinea* rather than of any other amphibious plant. One could not be certain, however, unless the terrestrial plants growing near had also been collected. Collectors will some time perhaps realize that it is impossible in many cases to tell the difference between what is called "*P. amphibia*" and "*P. emersa*," when the above description of the "real" *P. emersa* or (*P. coccinea*) aquatic is compared to the description of "*P. amphibia*" as outlined in our manuals, and understood by most botanists today. As the manuals describe the two plants, one can readily see why we might conclude on a very conservative basis to suppress *P. emersa* altogether, with *P. Hartwrightii*, unless, as I have pointed out, another system of distinctions be adopted from that of the manuals of today.

C. W. Short, Kentucky, 1840, also in the N. Y. Bot. Garden Herbarium contains as one of the specimens what might be *P. coccinea* in its aquatic phase. If the two specimens are found one plant, it is an interesting fact to deduce, that our older collectors were more careful than in recent years to gather complete plants!

Another specimen from the Torrey Herbarium "New York near Albany." also "H. H. Eaton's, Troy." also Letterman's. Valentine, Mo. VIII, 1903. (?) G. L. Clothier's No. 458. 1896. The last specimen has four spikes of flowers! J. B. Norton's No. 458 Riley Co., Kan. VII., 22. W. Eggleston's "Western Vt." IX, 23, 1899. This plant has the aspect of the terrestrial *P. mesochora*, and thus resembles the plant I found along the Potomac, as already referred to.

From Mr. Chas. Deam I have his No. 1700 from the banks of

the St. Mary's River, South of Fort Wayne, Allen Co., IX. 16, 1906.

In my own herbarium I may note the following collected by myself.

No. 12, Notre Dame, 1907. Sterile. No. 910, Kizer, Dollar Lake, Ind., VI., 26, 1911. No. 691, Notre Dame, 1910. No. 376, X., 10, 1909.

This is *P. coccinea* var. *asprella*: No. 2242, Notre Dame, 1909. No. 8987, pond near Studebaker's Woods, South Bend, Ind., VII. 12, 1911. The plant is sterile and corresponds to Var. *asprella*.

No. 261, Notre Dame, IX., 16, '09, var. *asprella*. No. 1809, Studebaker's Woods, South Bend. IX., 16, 1911. This is the variety *asprella*. Some of the stems have the very narrow and small foliage characteristic of ordinary *P. mesochora* in its terrestrial phases. No. 742. Sagunay, Ind., near Hudson Lake. IX, 29, 1910.

No. 1618. Virginia, banks of the Potomac opposite Plummer's Island, D. C. Specimen No. 1618x from the same rootstock as 1618 is so much like the terrestrial of *P. mesochora* with its narrowed small leaves, that one could hardly tell them apart, and not knowing the origin of the plants, one would undoubtedly classify them as terrestrial phase of *P. mesochora*.

These are properly *P. coccinea* var. *asprella*. Other specimens of the variety *asprella* in its various phases are the following from Millers, Indiana and vicinity, collected at various times. The variation in numbers indicates either different dates of collection or different places.

No. 3006. Along I. H. R. R. IX. 21, 1911. A full grown blooming specimen, as is also the following from another place nearby.

No. 8988. Collected same day as the above; both terrestrial
No. 2095 from another pool has narrower leaves.

PERSICARIA COCCINEA var. ASPRELLA Greene, Leaflets Vol. I., P. 36.

AQUATIC PHASE. The plant in the aquatic state resembles as to glabrous foliage perfectly that of the species. The plant never blooms in this phase, but soon emerges assurgently out of shallow water as the aërial leaves enlarge and one after another become nearly twice as long and broad. In June one may find such sterile aquatic phases with leaves 6-12 cm. long and 2-4

cm. wide: (some of the leaves are long and narrow, 3x12 cm.) obtuse or acutish at the apex rounded to cordate. As the leaves change to those of the terrestrial the upper part of the petiole is often winged with abrupt sinuses where it passes into the blade petioles often 4 cm. long.

RIPARIAN PHASE. The plant not only fails to bloom in the aquatic phase but the aquatic plants are never to be found at blooming time. Aquatic branches are, by elongation in growth rapidly changed into riparian ones, which are strictly speaking only aquatic branches in the condition of transition to terrestrial, or terrestrials with the lower foliage passing into aquatic when the glabrous floating leaves are still present. Such riparian leaves are characterized as having the upper part of the petiole winged and with abrupt sinuses when the wing passes into the blade.

The type of the aquatic I may designate as numbers 857a and 859a collected by myself at Millers, Indiana in pools along the old Indiana Harbor Railroad. June 1, 1911. Numbers 856ab and 859ab represent types of the riparian plants. The two numbers are the same variety collected in different pools. Numbers 856b and 859b and 859c are specimens in which the foliage characteristic of riparian and aquatic plants is absent due to the fact that the plants grew nearly out of the water. The plants are, of course, all sterile.

The petioles of the riparian plants are sometimes quite long and this often is the case when the leaf-blades are quite of the terrestrial type. I deduce from the analysis of many different kinds of *Persicarias* that the length of petiole depends more on the available amount of moisture the plant can obtain, rather than actual immersion of the leaves, whereas the pubescence of the leaves depends on the extent of actual emersion. One will often find plants growing in boggy places with a large supply of water, but actually unable to float that have typically pubescent leaf blades with the long petioles of the aquatic leaves.

PERSICARIA PRATINCOLA Greene, Leaflets, Vol. I., p. 36.

AQUATIC or SUBAQUATIC PHASE. Plant at first free-floating but later assurgent with only the first and lower leaves glabrous slimy; leaves long-petioled, long acuminate, truncate at the base 9-12c m. long 25-4 cm. wide; margins almost parallel

or slightly wider at the middle of the leaf, which is lanceolate to oblong of a bright green but later paler, and soon withering as the terrestrial foliage replaces the few aquatic leaves: petioles to oblong of a bright green but later paler, and soon withering as the terrestrial foliage replaces the few aquatic leaves: petiole 4-5 cm. long, slender; The upper terrestrial leaves are larger, longer 13-15 c. long 4-5 cm. wide acuminate, and rounded at the base, elliptic oblong or elliptic oval. The intermediate leaves are at first rounded, then cordate at the base and then change gradually to the normal terrestrial subcordate to cuneate. The intermediate leaves with cordate base are glabrous, but not slimy aquatic being emersed, and are oval or ovate in shape. The petiole gradually becomes shorter as the leaves pass to the terrestrial.

What I may designate as type phases were collected along the St. Joseph, South Bend, and Southern Railroad in St. Joseph Co., Indiana, between Lydick, Ind. and Galien, Mich. about two miles from the state boundary. They are nos. 923a (two sheets) and 923aab, and were gathered June 15, 1911. The plants are therefore sterile, and it may be inferred that the strictly aquatic phase of *P. pratincola* is vestigial, represented by only a few leaves at the base of such stems as are found near or in shallow water. Even if the water remains the stems elongate and later produce only terrestrial foliage. The species, therefore, like *P. grandifolia* bears all the phases consecutively on one shoot, but differs in that the aquatic is the merest vestigial remains, to be looked for and found only when the plants appear early in the season, and when not yet blooming. Some strictly aquatic plants were found, but had only a few first leaves. The habitat of the plants was a small pool only a few feet wide, evidently filled with water only in spring and early summer. It appeared as if it might once have been an animal wallow, though no animals could have been near for years as it was surrounded and invaded by rather old underbrush. The pool was in a field in low ground, and surrounded by normal terrestrial plants of *P. pratincola*, also present in my herbarium as Nos. 923 c, 923d, 923 de. No. 922 is another terrestrial found not far from this place. Other specimens of *P. pratincola* I may here refer to from the U. S. National Herbarium are the following.

No. 230396, B. Fink. Fayette Co., Iowa, VIII. 1894; 324300,

J. M. Mill's No. 529, Mt. Pleasant, Iowa, VIII. 1887; 353194, J. B. Norton's No. 458, Riley Co., Kan., VII. 22; 235324, J. N. Rose and Geo. Clinton, VIII. 28, 1895. The last is labelled, "A bad weed in Illinois." The spikes are 10 cm. long. Though Dr. Greene in publishing this species gave no reference to a special plant designated as type, we might suspect that he had this specimen in mind when commenting on it as a rank weedy species of low praries in Indiana, Illinois, Iowa, and Missouri."

324365, E. Johnson's No. 622, Ames, Iowa, IX. 14, 1897; 281163, B. F. Bush's No. 397, Courtnay, Jackson Co., No. VII. 15, 1896; 318289, K. Mackenzie's 313, Sheffled, Mo., VIII. 1, 1897; 308100, Glatfelter, Creve Cœuer and St. Louis, VIII. 31, 1895.

216246, W. C. Stephens. Lawrence Kansas. Aug. (Labelled as "*P. amphibium*." 430106, W. F. Wight's no. 49 Hutchins Lake Ganges Tp. Mich. Labelled "*P. pennsylvanicum* L." A very narrow leaved specimen that may be distinct. 490346, A. J. Peters. Put-in-Bay, O. VIII, 1898.* Sterile. 444735, L. Mosely, Oxford, Erie Co., Co. IX. 2, 1895. 444733 S. H. and D. R. Camp's Jackson Co., Mich, IX, 31, 1893. 444736 L. Mosely Oxford, Erie Co., O., IX, 2, 1895. 343362 Mark White, Arkansas City, Ark., VIII, 4, 1898. 353195 ——— no. 458a Swamps, Riley Co, Kan. 353383 B. W. Everman, Lake Maxinkuckee, Ind. VIII, 15, 1899.

Herbarium U. S. Dept. Agric. Tom A. Williams (2 specimens). 1200 feet, Nebraska, VIII, 1, 1889.

Herbarium N. Y. Bot. Garden. B. F. Bush's, 4176, Sully, Mo. X, 10, 1904, also B. F. Bush's 4150. Dodson Mo. X, 10, 1904. J. B. Norton's 292, Manhattan, Kan., VII. 22, '95. L. M. Umbach, Dune Park, Ind. IX, 2, 1898. Paul J. White's, Custer Co., Okla., VII, 21, 1900. Herbarium of Mr. Chas. Deam, Duplicate of the preceeding also of L. M. Umbach's IX, 2, 1989, Dune Park, Ind.

PERISCARIA VESTITA Greene, (1904) Leaflets, Vol. I, p. 38.

B. C. Taylor's, ———, Minn., VIII, 1892. N. Y. Bot. Garden. another specimen gathered at Brookings, S. D., VII, 1894. P. A. Rydberg's 1613, Whitman, VII, 29, 1893. The lower leaf seems to be riparian or subaquatic. All from the Herbarium of the New York Botanical Garden.

* Roman numerals indicate month collected, the others before the year show the date of the month. e. g. IX. 2, 1895 means Sept., 2, 1895.

PERISCARIA GRANDIFOLIA. Greene (1904) Leaflets, Vol. I, p. 37:49.

The following plants in the U. S. National Museum may be referred to this species.

649547. E. A. Mearns, Ft. Snelling, Minn. VII, 24, 1888. (Duplicates in New York Botanical Garden Herbarium.)

670719 E. Mearns Camp Douglas, (Probably *P. grandifolia*?)

444734 Mosely. Willows Pt. Sandusky, O. VIII, 17, 1895.

649546 Edgar Mearns, Fort Snelling, Minn., VII, 24, 1888.

E. P. Sheldon's Mira, Kanabec Co, Minn., VII, 1892.

I have since found the plant growing at the edge of a pond, South of South Bend, and west of Studebaker's woods, together with a new species to be described. The plant is represented by numbers 942x and 942y collected July, 12, 1911. Some of the leaves are typically aquatic below.

PERSICARIA RIGIDULA (Sheldon) Greene, (1904) Leaflets Vol. I. p. 24. and 39.

The plant is closely allied to *P. grandifolia*, and had the same habit of growth, rising rigidly and assurgently from aquatic branches. Hitherto it has been known as an aquatic only. Dr. J. Lunell has sent me a specimen with explicit notes, one sheet of which proves to be the strictly terrestrial phase of the plant. When growing in dry soil the plant is "always sterile," and under these circumstances has smaller, or at least differently shaped leaves with short appressed characteristic pubescence, and of course lacks the fistulous stems.

RIPARIAN PHASE. There is another very peculiar habitat in which the plant has the characteristic appearance of the sterile terrestrial as to the stem and leaves, but blooms freely. Concerning this Dr. Lunell says, "I believe this form has to be called riparian. Bottom of lowest course of ravine, boggy and thoroughly soaked, but no visible water." The specimen is over a metre high and has been broken off at that. The leaves resemble those of the terrestrial phase except that they are much larger, and the nodes are somewhat swollen. The specimen was collected Aug. 12, 1906 at Butte Benson County, N. Dak., by Dr. Lunell. Another plant sent me by him was collected by J. F. Braenkle at Kulm, N. Dak. July 20, 1910 and though smaller shows the characteristic creeping habit sending up new aerial shoots.

in this case from "shallow water and mud." This aerial plant is then quite of the appearance of a terrestrial, but is, as is evident from the description of the habitat, a dweller of wet places. It may be classified as riparian, since Mr. Braenkles' plant rose from shallow water.

TERRESTRIAL PHASE. Plant always sterile, assurgent from a thick green prostrate stem: leaves 7—14 cm. long, 3-4.7 wide, oval or elliptic-oval, but for the acuminate apex, scarcely ovate, sometimes elliptic-oblong, (the aquatic leaves are ovate often broadly so) short petioled hardly 1 cm.; covered with very minute fine pubescence which is canescent on young foliage; somewhat roughish on the midrib; ochreae beset with longer appressed scattered hairs; stems densely leafy; internodes not over 6 cm. long swollen near the nodes; stem commonly glabrous or pubescent like the ochreae.

As type I select no 10078 of my herbarium sent me by Dr. J. Lunell, and collected by him Sept, 8, 1911 at Butte, Benson Co., N. Dak. The plant is always evidently sterile unless growing in places where moisture is abundant. Another sterile terrestrial was sent me later by Dr. Lunell, collected in the same place Aug, 28, 1911, in damp places, but without visible water.

A typical aquatic is in Mr. Chas. Deams' herbarium, which he kindly sent me for examination. The plant was collected near Leeds, N. Dak. by Dr. Lunell, Aug. 7, 1901. No 10077 in my herbarium, also collected by him Aug. 7, 1911, is singular in having a flowering shoot accompanied on the thick fistulous aquatic, by a sterile terrestrial shoot. The latter establishes beyond a doubt connection between the aquatic and riparian, and sterile terrestrial phases! In all cases except Mr. Dean's specimens the aquatic foliage has disappeared almost entirely.

PERSICARIA LONCHOPHYLLA Greene, (1904) Leaflets Vol. I. p. 37.

U. S. Nat. Herb. no. 593950 O. A. Farwell's VIII, 1892, C. C. Deam's Herb. his plant from dunes 2 m, E. of Indiana Harbor, Lake Co. IX, 8, 1907.

Persicaria tanaophylla. Nwd., nov. sp.

PLANTA TERRESTRIS. 5-10 dm. vel altior e rhizomate radicante in locis subhumidis: caulis plus minusve tenuis cum internodiis longis in aliis plantis innixus sed erectus: Folia oblonga vel

anguste lanceolata, apice acuminato, et basi cuneato, obtuso vel raro subcordato, circa 5-6-plo longiora quam lata cum, marginibus ciliato-scabris subparallelis. (Adsunt quidem folia 21.5 longa et tantum 3.3 cm. lata): Petiolus 1-3 cm. longus; folia adpresso-strigulosa vel cum pilis sericeis albis plus minusve longis praesertim in facie inferiore; vena media scabra vel adpreso-hirtella, vel muriculata. Folia 8-22 cm. longa et nunquam plus quam 4.7 cm. lata, et longissima circa 3.5 cm. lata vel angustiora: folia juniora sericeo-canescientia; folia seniora vel matura et quoque ochreae, sparse adpresso-hirtella: nodi intumescences. Pedunculi 5-10 cm. longi tenus et minute glanduloso-pubescentes et aliquando hirtelli spicae circae duae, 5-6 cm. longae lanceolatae quando florent et cum floribus seriatim floresentibus binis vel trinis seriebus. Bractee ovatae, hirtellae, et ciliatae pilis longioribus fuscis. Flores infundibuliformes, rosei et deinde rubro-purpurei. Calix dum fructus maturat, basim attenuatam habet. Semen lenticulare et in latere altero planum, et stylis binis praeditum usque ad medium vel inferius divisum. Stamina rubra versatilia, exserta, et stylis coaetanea.

PLANTA RIPARIA VEL SUBAQUATICA cum caulibus erectis, brevibus, circa 2 dm, longis super aquas vadasas natantibus, et e caule majore, longo, radicante se erigentibus. Folia elliptico-oblonga vel lanceolata, praesertim ea in caule inferiore, glabra 7-13 cm. longa (cum petiolo 1-2 cm. longo): cum basi cuneata vel in superiore caule rotundata et subcordata; cum apice acuto. Ochreae margines desunt omnino. In caule superiore ochreae strigulosae vel scabrae, et aliquando, ut in caule inferiore, glabrae, et aliquando ut in caule inferiore, glabrae et limosae, tenues, et membranaceae. Spicae 3.5 cm. longae, emersae, angustae, cum floribus pro planta perparvis infundibuliformibus. Pedunculus circa 5 cm. longus, leviter pubescens in parte superiore. Bractee glabrae, fuscae, cum apice aristato vel cum aristis paucis.

Terrestrial Phase. Plant 5-10 dm. high from a creeping rhizome, rooting at the nodes, and usually though erect more or less supported by other plants especially shrubby. Leaves narrowly lanceolate or even linear-oblong, acuminate at the apex, usually sharply cuneate at the base, or obtuse, (and very seldom subcordate) long and narrow generally 5 or 6 times as long as broad, the lower leaves with subparallel ciliate scabrous margins (in some cases leaves actually 21.5 cm. long and only 3.3 cm. wide.)

Petiole 1-3 cm. long. Surface of the leaves minutely strigulose with white rather long hairs, often appearing fine and silky even under the lens. Midrib minutely scabrous to appressed hirtellous, or appressed muriculate. Leaves 8-22 dm. long and never more than 4.7 cm. wide, the longer leaves rather often comparatively less wide than the upper shorter ones. Young leaves appressed silky canescent, or sometimes glabrate; sometimes the older leaves, and the ochreae always appressed hirtellous. Nodes slightly swollen: peduncles very slender minutely glandular pubescent sometimes pubescent upward, 5-10 cm. long: spikes 5-6 cm. long, lanceolate in flower, linear in fruit, the rose-red flowers blooming in consecutive series gradually spreading upward, so that the flowers appear sometimes in 2-3 circles giving the spike an attenuate appearance in the middle. About three sets of spikes in twos are produced in a season, a new branch ending in the new inflorescence appearing in turn from the axil of one of the upper leaves. The peduncle enlarges in fruit and all the parts of the spike except the tawny hirtellous bracts are soon dehiscent. Bracts triangular ovate, and ciliate with long brownish hairs. Flowers perfectly funnellform, rose-red, the calyx becoming dark purple to carmine in fruit. Calyx attenuate below the seed in fruit shining black lenticular flatter on one side. Flowers rather loosely aggregated in the spikes early in the season. Stamens with rose-red, exserted, versatile anthers, longer than the red, globular-tipped, coetaneously exserted styles which are divided to below the middle.

It would seem that the first spike of the season, as also the aquatic spikes, are quite uniformly sterile. It is not quite certain whether the plant is to be referred to the *emersa* group or to the following, but it seems quite safe to put it as next of kin to the following plant to be described, as also next to *P. mesochora*. Though I have visited its habitat in early summer I have been unable to find any trace whatever of borders to the ochrea tips. In shape of leaves it shows kinship to *P. mesochora*, or even *P. ammophila* for that matter, though the spikes differ much from those of the latter. If the plants ever even in the spring terrestrial phase have the herbaceous borders of the ochrea, they are vestigial, and soon disappear, even sooner than in the two following plants, where such structures may be found occasionally even at blooming time in sterile specimens. I have found plants with traces of borders at Millers early in the season which certainly were not

P. ammophila, everywhere so abundant there, but no collections of such specimens were made at the time and the identity of the plants can not be positively proved. Moreover, the locality is rich in many amphibious Persicarias, some of which resemble *P. mesochora*, or *P. lonchophylla*, or even, *P. carictorum*.

I may designate as type of the terrestrial phase, which seems to be the normal condition of the plant, No. 1901, of my herbarium gathered at Millers, Ind., July 9, 1911. Numbers 1901a and 1901b show the long narrow leaves so characteristic of the species, as also the ever-present brownish color of the lower surface of the leaves later in the season, that distinguishes it from all other members of the *emersa* group. Other typical specimens are numbers 1903 collected in another place some distance from the first locality and on the same day. Numbers 2096 and 2099 gathered in the same place, Sept. 21, 1911, as also 3002, 3004, and 3005. Numbers 3002b, 3002c and 3004c are riparian plants with upper terrestrial foliage and the lower leaves about $\frac{1}{3}$ as long, though of nearly the same width, and glabrate, due to previous immersion in shallow water. The most striking of these intermediate riparian phases is sheet No. 1903a which has lower aquatic leaves much shorter, and as broad aquatic ovate oblong to lanceolate, that are quite glabrous, with broad base and acute apex, whereas the upper are nearly twice as long and acuminate. The petioles gradually shorten upwards, and the specimen is as perfect a fertile transition phase as I have been able to find. It was collected July 9, 1901. No. 2465 is the nearest approach to the aquatic phase I was able to obtain late in the season. The lower foliage though scabrous margined has the long petioles of the water plant though the leaf shape is not characteristic. It is more riparian than either strictly terrestrial or aquatic. Even riparian blooming plants of the species are rarely to be found.

SUBAQUATIC PHASE. Plant with small floating leaves ovate to elliptic-ovate, acute, subcordate or rounded at the base and not over 9 cc. long when on sterile plants, about 2 cm. longer in the largest of upper leaves on fertile plants, and 1.5-2.6 cm. wide and ovate or ovate-oblong. Petioles 1.5-3 cm. long perfectly smooth. The plant blooms rarely in this phase and apparently the flowers do not mature seed. The smaller stems rise from a long upright one in shallow water and as they rise out of the water soon change to terrestrial or riparian. I select as type

No. 1906 collected with the terrestrial No. 1901 at Millers, Ind., in the same pool July 9, 1911. Numbers 1904 and 1905 are sterile aquatic shoots gathered nearby. They are more typically aquatic in nature of the foliage, as No. 1905 has traces of pubescence on leaves just forming that connect it without doubt with the terrestrial phases of *P. tanaophylla* as just described. I choose No. 1906 in preference to the more typically aquatic 1904 and 1905, because the latter are sterile. The choice, however, is arbitrary, for my experience shows that the aquatics are normally or at least commonly sterile.

Subsection II. HARTWRIGHTIANAE.

Plants having more or less spreading herbaceous borders to the ochreae usually in the terrestrial phase, sometimes only in the terrestrial spring sterile and disappearing later.

Persicaria carictorum Nwd. nov. sp.

PLANTA TERRESTRIS VERNA circiter 6 dm. alta. Forma foliorum maxime differt ab ea foliorum plantae aquaticae. Folia 9-19.5 cm. longa 2-5 dm. lata cum petiolis 1 cm. longis, densis pilis et sericeis mollibus plus minusve divaricatis induta, praesertim juvenilia; pilis in venis et petiolis praesertim divaricati. Ochreae dense sericeo-hirsutis pilis obsitae, et in infundibuliformem vel campanulatum marginem herbaceum ciliatum terminantes. Folia anguste lanceolata cum baso rotundato vel obtuso et apice longe acuminato in fine obtusiusculo. In plantis caulem inferiorem adhuc aquaticum habentibus, folia superioris partis terrestria, semper dimidio angustiora et longiora sunt!

PLANTA TERRESTRIS AUTUMNALIS unica fertilis, plus minusve erecta 3-8.5 dm. alta, assurgens e rhizomate in humidis vel aridis locis radicante. Internodi 3-7.5 cm. longi: nodi haud intumescunt. Folia inflorescentiam superantia 7.5-17 cm. longa, 2-4 cm. lata, pubescentia ut in planta terrestri sterili. Ochreae molliter sericeo-hirsutae pilis plus minusve divaricatis et omnino et semper margines divaricatos carentes. Folia juniora pilis sericeis appressis canescentia. Spicae 1-3 saepissime 2, altera prior et senior, circa 5 cm. altera junior 2 cm. longa. (Quando 3 adsunt, omnes fere aequae longae circa 2.5 cm.) Pedunculi 3-4 cm. longi, tenues, et glandulosis pilis divaricatis induti. Bractae ovato-triangulari-

formes dense hirsutae et hirsuto-ciliatae. Calix breviter campanulatus roseo colore: stamina exserta; anthera versatilia: styli longi tenues usque infra medium furcati, longe exserti, et staminibus coetanei vel juniores. Semen pro planta perparvum, nitidum, fuscum et crasse lenticulariforme. Floret haec species in planta terrestri tantum, a Julio usque Octobrem in carictis prope ad stagna.

PLANTA AQUATICA VERNA AESTIVALIS semper, sterilis. Folia viridia ambabus faciebus, in aqua natantia, glabra, nitentia et limosa, elliptica-ovata vel elliptico-oblonga media parte latissima, cum basi obtusa, rotundata vel subcordata (in foliis superioris caulis), cum apice acuto, 5-11.5 cm. longa et 1-4 cm. lata (saepissime 3x9 cm.) Petioli tenues 1-4 cm. longi: internodi 2-4 longi ubi folia virescunt, internodi inferioris caulis multo longiores. Nihil differt planta aquatica autumnalis praeterea quod folia sunt magis venosa et purpuata. Plantae ipsae aestivales et praesertim autumnales, ambae steriles, perrarae sunt et nunquam nisi in vadis umbrosis inveniuntur.

Terrestrial Phase. Plant about 6 dm. high, leaves 9-19 cm. long 2-5 cm. wide, exclusive of the petiole which is 1 cm. long (sometimes 2 cm. in glabrate broader leaved riparian plants, with rather wide borders to the ochrea, and long internodes, growing in shady places.) Leaves persistently covered on both surfaces with white soft silky spreading hairs and particularly on the ochrea and petioles of older plants, often in appearance somewhat tomentose, growing foliage white with more appressed soft hairs. Older ochrea more or less densely hirsute or hirtellous with soft hairs, and tipped with salver-shaped or campanulate herbaceous ciliate borders that gradually diminish in size upwards on the stem, and are seldom present even on sterile plants at blooming time, never on flowering terrestrials. Location in shady or sunny and dry places, varies only the amount and sparseness of the pubescence not its character. Leaves generally long narrowly lanceolate, with a rounded or obtuse base and a long acuminate, but finally blunted apex. When the plant is riparian, *i. e.*, still has its lower leaves aquatic, subaquatic or but lately emersed, the pubescent upper leaves are generally at least one half longer and one half narrower than the smooth lower ones.

Specimens have been found of normal terrestrials with lower subglabrate leaves that evolved gradually by continued growth

from a normal aquatic plant earlier in the season. Internodes in this case 5-9 cm. long, the leaves are broader, subcordate, and varying from glabrous to pubescent as above described. Such plants were found in the shade of *Cephalanthus occidentalis* Linn. bordering the pond.

Fertile Terrestrial Phase. Plant more or less erect 3-85 dm. high assurgent from a rootsrock creeping and rooting in mud or wet places, (the plant never blooms except where a good supply of water is present in the soil even in the terrestrial plants.) Internodes 3-7.5 cm. long: nodes not noticeably swollen: foliage usually overtopping the spikes. Leaves 7.5-17 cm. long and 2-4 cm. broad: pubescence as in the spring sterile terrestrial. Ochrea soft silky hirsute with more or less spreading hairs, and always entirely devoid of herbaceous margins. Young leaves silky shining with appressed hairs. Spikes 1-3 usually 2, one older, the larger about 5, cm. the second 2 cm. long, (when 3, all about the same length). Peduncle 3-4 cm. long slender and beset with rather long spreading fine gland-tipped hairs. Bracts ovate triangular ciliate, and densely covered with straight appressed brownish somewhat rough hairs. Calyx rose-red short campanulate: stamens versatile with rose-red anthers long-exserted: styles exserted, long, slender, forked below the middle with red globular stigmas, coetaneous with the stamens. Seed small, brownish, shining, thick, biconvex. Lowest flower not separate from the rest of the spike.

Aquatic Phase. Plant floating in shallow water along the shores of ponds, gradually elongating into terrestrial plants as water recedes or dries up. Leaves with borderless ochrea only aquatic and smooth when and as long as water is present. Submerged parts all smooth and, when young, slimy also. Leaves shining dark green on both sides, elliptic-ovate or elliptic-oblong widest near the middle, obtuse, rounded or the upper subcordate at the base, acute or sometimes somewhat obtuse at the apex, 5-11.5 cm. long and 1-4 cm. wide, the average leaf about 3x9 cm. Petiole slender 1-4 cm. long: internodes 2-4 cm. long where the leaves persist, but lengthening out considerably when old.

The aquatic phase seems to be merely vestigial, or transitional to the blooming terrestrial. Plants on high dry land seldom flower in the terrestrial phase, and the aquatic seems to serve only the purpose of starting the growth early in the season.

Good examples of the aquatic phases are my numbers 917a, 917ab, 916a and 916ab, 917aab. Numbers 917abb and 917b are good riparian specimens, and 917c, 917cd, 917d, 917de, 916e, 916ee, 917ee show all the intermediate transitional phases from the first, which is strictly aquatic, to the last which is strictly terrestrial, having lost all trace of borders to the ochreae. No. 917d had leaves 20 cm. long and less than 5 cm. wide. Nearly all the aquatics show traces of the beginning of terrestrial foliage. All were collected June 22, 1911 around and in a small pond about a mile in circumference west of Studebaker's Woods,* and south of South Bend, Indiana.

No. 917ee may be chosen as type of the sterile terrestrial phase. It begins already to lose the borders of the ochreae. No. 917a may be considered as a good typical spring aquatic. No. 941y represents the summer and fall aquatic as also 941x. Both were collected July 13, 1911 at the same place. No. 941bcd, gathered at the same place, on the same day, shows the characteristic fall sterile plant.

As the type of the flowering plant No. 941bcde is the best example and this is in fact the type of the species. The specimen was collected July 12, 1911 at the above mentioned locality. No. 941b is a unique example only one of which I have been able to find during several years that I have frequented the place, of a riparian blooming plant. The lower foliage is typically aquatic with three glabrous long petioled leaves; the upper foliage is typically terrestrial. No. 1806 shows the fruiting plant gathered Sept. 19, 1911, at the same place.

This plant is readily distinguished from *P. mesochora*, its nearest ally on the one side, by the fact that it never blooms in the floating aquatic phase, as also by the characteristic habit and pubescence. It is intermediate between *P. mesochora* and *P. tanaophylla*, and distinguished from the latter in the presence of borders to the ochreae as well as the pubescence and shape of foliage. The latter also blooms at least occasionally in an aquatic condition. As far as habit is concerned, the plant connects the members of the *Hartwrightianae* as a group to which it strictly belongs, by means of *P. tanaophylla* to the *Emersae* group. Any one not knowing its spring phases would unhesitatingly class *P. carictorum* as a near ally of *P. coccinea* and *P. praticola*, or more likely near *P. vestita* which in bloom it somewhat resembles, but

for its remarkable pubescence. On the other hand, the sterile spring phases with unmistakably large margins to the ochrea leaves it as a closer ally to *P. Hartwigii* in spite of the appearance and habit of the flowering plants. To sum up *P. tanaophylla* still blooms in the strictly aquatic phase and, not having margins to the ochrea, is a member of the *Emersa* group. *P. carictorum* has only a vestigial aquatic phase in which it never blooms, and has borders to the ochrea in terrestrial plants, but only in sterile spring plants. *P. mesochora* with a different foliage from the latter blooms evidently more normally in the aquatic than the terrestrial phase, and has margins to the ochrea in spring plants only and is glabrate in the terrestrial flowering phase.

I have met in the U. S. National Herbarium but one specimen that may possibly be referred to this species, and that not with absolute certainty, as it is only a sterile plant. It is No. 148853, collected by H. N. Patterson at Oquawka, Ill. in the Mississippi bottoms. No date is given beyond "Sept.", without day or year.

P. carictorum seems to thrive best along the borders of a pond where it is near water, or in muddy boggy places among sedges and *Dulichium* species. It is abundant in the shade of the southern shore growing under willows and *Cephalanthus* the shade having no apparent effect on the pubescence of the plant. Other plants of the group growing with it are *P. grandifolia* and *P. coccinea*.

PERSICARIA MESOCHORA Greene (1904) Leaflets vol. I., p. 28.

Of the specimens of this species which I have found in the U. S. National Herbarium and that of the New York Botanical Garden, the following are more or less notable.

U. S. National Herbarium: 443325, Slough, Dune Park. IX., 7, 1903. Collector's No. 2097. Terrestrial phase. 434581, R. Cratty's Emmet Co., Iowa, VII. and VIII., 1895. Aquatic. 284691, J. Macoun's Hull, Ontario, IX., 6, 1889. Riparian or subaquatic. Labelled "*P. emersum*." 593947, O. A. Farwell's 352, Belle Isle IX., 23, 1892. Aquatic. "Deep water, stems several feet long." Marked "*P. amphibium coccineum*." 343986, W. C. Kendal's N. Windham, Me. VII. 6, 1889. Aquatic. (Owing to the close resemblance of the aquatic phases of *P. mesochora* and *P. coccinea* though otherwise so very different, this specimen is more likely to be the aquatic of the latter.) 45465, F. V. Coville's

Potomac Flats, D. C., V. 11, 1890 (?). This is a sterile terrestrial labelled *P. Hartwrightii* with spreading tips to the ochrea, and more closely resembles *P. mesochora* as to vegetative characters. Owing to the incompleteness of the specimen its status may be considered as indeterminable from the material at hand. 295743, F. V. Coville's Preston, N. Y., VII, 28, 1886. Also sterile but with the foliage of *P. mesochora*. 295748, F. V. Coville's Ithaca, N. Y., VII. 27, 1885. Also sterile, but aquatic. Labelled "*P. amphibium*." U. S. Dept. of Agric. Herb., F. V. Coville's Oswego, N. Y. VI. 29, 1887. Sterile terrestrial.

New York Botanical Garden Herbarium: W. F. Wright's Allegan Co., along the Kalamazoo River, IX. 10, 1902, in 3 ft. of water. Aquatic. N. L. Britton's Buffalo, N. Y., VIII. 20, 1886. O. A. Farwell's 325a Belle Isle, Mich., IX. 23, 1892. Aquatic phase. P. A. Rydberg's, Platte near Horse Creek, VIII. 1, 1891. This most resembles the aquatic phase of specimens of which I found the terrestrials on the same rootstock at Notre Dame. Stewart H. Burnham's, Bacon Pond, Washinton Co., N. Y., IX. 20, 1900. Labelled "seems a form of *P. amphibium* L. growing where water subsided." One specimen has leaves passing into those of the aquatic but smaller. All the specimens are like those I found here at Notre Dame.

From C. C. Deam's Herbarium a specimen from Steuben Co., Ind. VIII. 13, 1903. Swamps near tamarack lake, also his number 298, Noble Co., Waldren Lake, Orange Tp., VIII. 9, 1905.

I have collected the following specimens of *P. mesochora*, all the plants being present in my herbarium. 864, Mineral Springs, Dunes of Lake Michigan, VI. 7, 1911. 906, Hick's Crossing on the Interurban Electric Line to Michigan City, V. 20, 1911. Another specimen No. 907. These plants are sterile and the ochreae borders have already disappeared. 844, St. Joseph's Lake, Notre Dame, Ind., VI. 2, 1911. Same locality as type of terrestrial already described in former paper.

PERSICARIA MESOCHORA var. *arenicola* Nwd., nov. var.

Planta terrestris fertilis differt a planta typica foliis magis strigosis pilis appressis. Internodes habet breviores hirtellos; ochreae ciliatas et spicas minores circa 2 cm. longas. Venas medias quoque habet appresse hirtellas quae in typica sunt tantum scabrae. Convenit plantae typicae forma foliorum et aspectu foliorum.

Folia in caule inferiore majora et longiora sunt. Desunt margines divaricati ochreae omnino quando floret.

Plantae sterilis terrestris folia ut in praecedente sed majore et dimidio longiora quam in *P. mesochora*. Internodi vero duplo longiora quam in planta typica. Adsunt margines campanulati erose-ciliati perparvi. Plantam aquaticam non inveni. Planta inter *P. mesochoram* et *P. ammophilam* intermedia.

Terrestrial Phase. Differs from the type in having the leaves more or less strigose with scattered appressed fine hairs. The internodes are shorter and the ochrea appressed hirtellous, with rather long hairs, the spike is smaller less than 2.5 cm. The mid-vein is appressed hirtellous and only scabrous in the type. It agrees with the type in the shape of the leaves and their general aspect. The leaves of the variety are larger below on the stem. The spreading ochrea margins are absent as in the type at flowering time.

Sterile Spring Plant. Leaves as in the fertile summer plant but larger and pubescence softer, leaves nearly one half again as long as in the corresponding phase of the type. The campanulate erose-ciliate borders of the ochreae are present but smaller and less conspicuous. Aquatic phase not seen.

The type of the new variety is a single sheet of a specimen gathered at Millers, Ind., Sept. 21, 1911, No. 2090. The spring sterile phase is represented by Nos. 857a and 857b found at the same place, June, 1, 1911. The plants have that marked characteristic of *P. mesochora*, viz., absence of ochrea border at the time of blooming. They have almost the pubescence of *P. ammophila*, but the latter always has the borders present when in flower.

PERSICARIA AMMOPHILA Greene, Leaflets Vol. 1, p. 47.

SPRING TERRESTRIAL PHASE. Plants rather variable in appearance ranging from very leafy glabrate specimens of moist habitat (internodes 2.5 cm.) to hirsute with nodes 5 cm. apart. Ochreae very hirsute with wide-spreading broad herbaceous ciliate types or borders often 2 cm. or more broad in sterile plants. This border is seldom wanting or withered in elongated specimens straggling over bushes and sedges, but often diminishing in size as the plant grows larger. Leaves oblong to ovate-lanceolate from glabrate with ciliate scabrous margins to strigulose and hirtellous, or hirsute, usually always with hirsute appressed ochreae, and

hirsute petioles and lower midrib. Base of the leaves obtuse or rounded: apex slightly acuminate or just acute; leaf broader usually near the middle or the margins subparallel for a considerable distance.

The plants with long internodes are found in grassy or sedge-covered places: the stocky leafy plant, in open sandy or muddy exposed places. Muddy or moist localities usually produce glabrate plants with leaves dark purple below, or with a v-shaped purple blotch above. The leaves are often 17 cm. long and the petiole not over 1 cm. The earliest leaves of terrestrials show a tendency to approach the shape, and often lack of pubescence, of aquatic phases, even when entirely removed from water. Good examples of the early summer terrestrial are Nos. 961 and 962 of my herbarium collected July 9, 1911 at Millers, Ind.

SPRING AND EARLY SUMMER AQUATIC PHASE. Leaves small always glabrous, purple beneath, yellowish-green above, 4-8 cm. long and 1-1.7 cm. wide, obtuse or acutish at the apex, always cuneate at the base, oblong to elliptic-oblong. Whole plant, especially growing foliage, slimy glabrous, ochrea margins only noticeable above on the stem, entire or erose and not ciliate unless aerial. Internodes 3.5 cm. or longer: stems, thin and wiry.

The aquatic phase of *P. ammophila* resembles that of small plants of *P. fluitans* or *P. canadensis*. Perfect resemblance does not long exist, as the plant soon emerges from the water, and the stems become thicker and aerial in character. I have found a remarkable series of specimens growing on one rootstock in a small pool at Millers, Ind., along the Indiana Harbor Railroad, June 1, 1911. The series of plants numbering eleven sheets all with several plants numbered 840a to 840k, contains all the intermediate transition forms from the strictly aquatic sterile to the normal terrestrial, all having been gathered not only from one small pool, but from one original rootstock! All the changes of the various organs of the plants as to pubescence, disappearance of parts, and appearance of others can thus be studied in their development under the changed conditions incident to the drying up of the pool. The terrestrials were found on the shore and transition forms at various distances into the deeper water of the normal aquatic. The specimens were not studied simply as dry herbarium plants, but selected after careful study of the specimens in the field. A mere glimpse over the series in order, is

sufficient to convince one more than anything else of the futility of studying, amphibious smartweeds from isolated plants or phases of such as have hitherto found their way into our herbaria.

Another almost similar series of the same phases of the same plant, I collected about eight miles southesat of South Bend, Ind., on the border of a tamarack swamp along the Turkey Creek Road, two miles west of Woodland. The plants number 915m to 915u were collected in a pasture along what was to all appearance the edge of the water before the large drainage ditch was dug that is rapidly destroying the largest tamarack swamp in St. Joseph County. Though not standing in water the lower leaves are glabrous, and resemble those of the intermediate transition phase of the preceding series up to the normal terrestrial. Doubtless later the plants become normal terrestrials, but when appearing early in the season, they have not as yet, though now high and dry, lost their tendency to grow their first foliage as subaquatic in appearance. The later growth of older plants is already distinctly terrestrial, though at first subaquatic in character, thus hinting at their previous history of submersion not many years ago. In other words the species *P. ammophila* survives because of its ability to change rapidly, even in one season, from aquatic sterile phase to the terrestrial.

Strictly normal aquatic phases, flowering with none, but floating glabrous foliage, I have not been able to find in spite of long and repeated search at various seasons of the year from the very first days of flowering until the spikes ran to seed late in fall. In one particular locality, at Millers, Ind., the plant is most abundant, and I have come to the conclusion that the plant has no strictly flowering aquatic phase, thus emphasizing beyond any doubt the utter impossibility, for the present at least, if my investigations are sufficient, of connecting *P. ammophila* Greene with such plants as *P. canadensis* Greene or *P. fluilans* Eaton, whose aquatic foliage resembles that of *P. ammophila*, but which flower only in the aquatic phase. If the specimens I found at Millers, flowered as normal aquatics we might infer that *P. ammophila* was but the terrestrial phase of *P. canadensis* or *P. fluilans*. But the first has never been known to bloom until the aquatic foliage was replaced by terrestrial at least in part, and the last two have not as yet been found with any terrestrial phase. It may even be likely from their deep water habit that they have

no terrestrial phase in that it is always a sterile one. In other words, *P. ammophila* is a normal terrestrial and *P. fluitans* and perhaps *P. canadensis* also normal aquatics. I wish to lay special stress on these facts; because at present it affords the best means of distinguishing all our various amphibious Persicarias from one another, especially when we find they have phases that closely resemble one another respectively, though always different beyond a doubt in at least one of them. The classification of these plants must therefore take account of the fact that the plants with similar phase or phases; but different in another or others, may be distinct, or as I have already intimated, we are logically forced to accept the other alternative that there is but one amphibious smartweed which is to be called *P. amphibium* Linn., and that the others are not even varieties; for all have the same reason for being either recognized or rejected. In fact what is called *P. emersa* or *P. coccinea* has less reason for recognition than most of them.

SUMMER AND FALL AQUATIC PHASE. Perfect aquatic leaves scarcely distinguishable from those of *P. canadensis* or *P. fluitans*, purple only in spring, or early summer. Stems wiry, internodes at times 9.5 cm. long. Leaves elliptical-oblong to perfectly elliptical, obtuse or acutish at the apex, always cuneate at the base; petioles 1-2.5 cm. long. Leaves glabrous, shining, slimy especially when young, typically without spreading margins to the ochrea which is membranous.

As already stated, to *P. ammophila* is distinguished from *P. canadensis* and *P. fluitans* in that it never blooms in the aquatic form but it soon emerges from the shallow water and becomes a riparian form, which has the upper foliage terrestrial in character. In this phase it blooms occasionally, but, about the time of flowering its chosen habitat has dried up, and the plants have all become terrestrials. It then produces one or two densely-flowered and especially densely-fruited spikes, that resemble those of *P. canadensis* in shape, with the exception that the parts are all more or less glandular pubescent or simply pubescent.

The water of the pools in which *P. ammophila* grows never dries up completely, there being usually a very deep and rather large part in the middle. The plant, however, clings to the shore where the water has dried up during part of the season, and the middle part is always left without any plants whatever. *P. fluitans*

and perhaps *P. canadensis* under similar conditions would avoid the shore, and grow only in deep water. This in itself is a character by which the collector may easily distinguish corresponding aquatic forms of each, no matter how much alike: for each species carefully selects its habitat.

I have in my herbarium forms illustrating all the transition stages from the normal aquatic to the terrestrial, also plants with all the various shapes and kinds of foliage in one specimen. I shall therefore not describe the riparian which in this case is a plant exhibiting all these transition characters on one individual shoot for it may easily be imagined by combining aquatic and and terrestrial with gradations from one to the other. It is needless to say too that aquatic plants are comparatively rare in flowering time, in spite of the abundance of flowering terrestrial, because of the evident tendency not to bloom in water, and not to venture in deep water. Aquatics in fall are found only in wet seasons when the water fails to dry up at the shore, or in case of an occasional straggling shoot that has ventured just beyond the drought line.

I have selected as types of the aquatic summer phase specimens No. 965b of my herbarium of which I collected three sheets at Millers, Ind., July 9, 1911. At another visit Sept. 21, 1911 I was unable to obtain typical aquatic plants. Specimens showing various transition phases to the terrestrial, *i. e.*, riparian plants, are the following: Nos. 963a, 963b, 963c, 962b, all sub-aquatic; 963d, 963e are more terrestrial in appearance, as also are 965a, 965e. 965f is subaquatic; 965g is subterrestrial, whereas 965h and 965j illustrate the last stages of transition to the true terrestrial phase represented by 965k and 965l. All these were collected at Millers, July 9, 1911.

Of the aquatics I could not find typical plants in fall, but only one straggling depauperate specimen No. 2465 hardly typical, and of course with out any apparent tendency to flower. No. 2098 found the same day, as also No. 2097 is decidedly transitional to the terrestrial, even these being rare at so late a date. Nos. 2465 and 3001 show the typical fruiting plants with characteristic dark purple red, some even bluish-purple or partly blue color of the fruiting calyx, as also the closely-flowered broad spikes. Flowering specimens in fall are characterized by rose-colored flowers (Nos. 2465c, 3003, 2097, 2466).

I found only two plants No. 961 blooming as early as July 9, 1911. They were growing high up on a dry sand pile or dune, about one hundred yards from any water, and twenty feet or more above the highest water line. Such a habitat I have found so unusual that it may be considered as teratological as the plants so found usually become very hirsute develop broad herbaceous ochrea borders, and large leaves. The plants became very leafy, and of the aspect of *P. asclepiadea* except for pubescence and remain sterile and very green, often with purple blotched leaves.

The following are the principal specimens of *P. ammophila* of the herbaria I have examined. No. 35 collected by myself 4 miles north of Notre Dame blooming on sand thrown up from the bottom of a ditch in the middle of a swamp at Webster's crossing. Dated VII. 8, 1909. The other specimens collected by me are all sterile and, but for their hirsute pubescence usually of the aspect of *P. asclepiadea*.

911, Oliver's, south of South Bend, Ind., on tracks of Grand Trunk R. R., VI. 27, 1911. 820, North Liberty, Ind., V. 11, 1911. 2732, Lawton, Mich., Edge of a pond near Bankson Lake. 369a, Webster's Crossing, 3 miles north of Notre Dame, X. 8, 1909. 909, Dollar Lake near Kizer, Ind., on Wabash Branch R. R., VI. 26, 1911. This specimen has subsessile leaves about 20 cm. long and the largest ochrea borders I have met in any specimen, over 2 cm. wide, erose ciliate. It grows among grasses and sedges around the pond.

857a, b, Millers, Ind., VI. 1, 1911. 919, on S. S. S. R. near Galien, Mich. (in Indiana). VI. 15, 1911; also 920 gathered at another place in the same railroad, and No. 918, collected nearby. 912, Chain Lake, VI. 21, 1911, and at another place about one half mile distant, No. 886; also 913. 2077, Chain Lake, IX. 26, 1911. Leaves broad elliptic 15.5 cm. by 4.5. 862, 2 miles S. of Stephenville, Mich., VI. 8, 1911. 39, Webster's Crossing, VII. 7, 1908. 88, Cultivated field southeast of Notre Dame. VI. 19, 1909.

U. S. National Herbarium. 407260, B. W. Everman's (1293) Lake Maxinkuckee, Ind., VIII, 15, 1899. 648937, Frank Gates', Chicago, VI. 31, 1905. 383069, L. M. Umbach's, Galt, Ont., VIII. 17, 1889. 607246, C. Dennis' (1209) Bass Lake, Steuben Co., Ind. 45460, B. C. Taylor, Center City, Minn., VIII., 1892. (Duplicate in Herb. N. Y. Bot. Garden.) 607246, Chas. C. Deam, (7209)

Grass Lake, Steuben Co., Ind., VII. 22, 1906. 593952, O. A. Farwell, IX., 1901.

Herb. of Chas. C. Deam. His specimen from Gage Lake, Steuben Co., Ind., VIII. 12, 1903.

It may be interesting in this connection that some one (perhaps Dr. A. Gray?) at one time had intended publishing what is a good specimen of *P. ammophila* Greene. A specimen in the N. Y. Botanical Garden Herbarium, originally from the Torrey Herbarium, collected Aug. 25, 1929, at Troy, N. Y. is thus labelled as indicated below. The following annotation is appended to the sheet.

"*Polygonum hirsutissimum* (mihi) a new one! Description. Stamens 5, stigmas 2, style 2 cleft, cylindric-ovate, thick round obtuse: general bracts about 2-flowered, each flower with a bract also. Stem assurgent simple or branching very hirsute; leaves oblong linear-lanceolate very hirsute, tapering gradually to the obtuse or subacute apex, subsessile subcordate at the base scabrous ciliate, stipules hirsute, long ciliate; peduncle smooth or nearly so, 12-24 inches long. Grows in great plenty in company with *P. mite* and *amphibium* var. *terrestris* in a lot 1 mile NNE of Rens. School. August."

PERSICARIA NEBRASCENSIS Greene, Leaflets Vol. 1., p. 47.

AQUATIC OR SUBAQUATIC PHASE. Plant with a creeping rootstock which is rather thick. Ochrea of the upper leaves membranous as in the terrestrial and slightly hirsute when emerging from the water. Leaves of the same shape as the terrestrial, but perfectly glabrous throughout, obtuse, rounded or subcordate at the base, and acute at the apex, broadest little below the middle, elliptic to elliptic oblong. Internodes 1.5-4 cm. long in branches and 4-11 cm. on the rhizome. Petioles short, .5-3 cm. long; bracts triangular acute, glabrous: seed almost lenticular, black. Peduncles short 1.5-2 cm. long: spike 1.5-2 cm. long.

The lower leaves are especially glabrous, and the upper reduced, sometimes appressed scabrous on the margin. They are smaller than in *P. ammophila* and on the terrestrial less hirsute. It is more than likely that typical aquatic phases will be found to have the habit and foliage resembling that of *P. ammophila*. The lower leaves of the specimen described are normally aquatic but the plant has recently emerged from the water the upper

foliage becoming somewhat scabrous on the margins. A good example is P. A. Rydberg's No. (1793) Grant Co., 3 miles NW. of Whitman, Nebraska, IX. 20, 1893. There is a duplicate in the Herbarium of the New York Botanical Garden. It may not exactly coincide in degree of pubescence in aquatic habit with the specimen in the U. S. National Herbarium, and I have not had occasion to compare them. The lower part of this plant is plainly what may be considered as the aquatic phase of *P. nebrascensis* Greene. This specimen was collected the same day at the same place by the collector, as the plant which Dr. Greene made the type of the provisional species. A better or rather more aquatic plant may be looked for than the specimen of Dr. Rydberg, but its lower foliage is unmistakeably aquatic, though the rest of the plant seems to have taken on subriparian habit. Dr. Greene in some way seems to have overlooked this specimen which with its foliage like that of *P. ammophila* and *P. canadensis*, and the habit of the former plainly shows it to be in every way a very close ally to it in all its phases.

Another plant in the U. S. Nat. Herb. that may be referred to here is No. 210177, P. A. Rydberg's (1653), VIII. 7, 1893, from the same place as 1793. In the N. Y. Botanical Garden Herb. are the following specimens of *P. nebrascensis*.

C. E. Bessey's from Ames, Iowa. The plant has its lower leaves aquatic. J. M. Bates', Valentine, Neb., IX. 1, 1891. R. I. Cratty's, Emmet Co., Iowa, XII., 1880. A good riparian phase with aquatic leaves below and transitional and terrestrial below.

PERSICARIA HARTWRIGHTII (A. Gray) Greene, 1904 Leaflets, Vol. I., p. 24.

Polygonum Hartwrightii, A. Gray, (1870) Am. Acad. VIII. p. 294, including *Persicaria abscissa* Greene, 1905, Leaflets, Vol. I., p. 108.

The following specimens of typical plants of this species may be referred to:

U. S. Nat. Herb. No. 593949, O. A. Farewell's, Keweenaw Co., VIII., 1904.

N. Y. Botanical Garden Herbarium: Torrey Herbarium. Oates, Ipswich, Mass. (Leaves about 10 cm. long elliptic oblong with spreading ochrea borders. A good example of the aquatic

phase.) T. C. Porter and N. L. Britton's. Swamp south of Lake Grinell, Sussex Co., New Jersey, IX. 17, 1887. Dr. Pitcher's Fort Gratiot, 1829. (Plant rather too pubescent to be typical.) O. A. Farwell's (351) Keweenaw Co., VIII., 1887. Aquatic phase. O. A. Farwell's (351) Belle Isle, VIII. 12, 1893. Somewhat strigose.

[Subsection III. HYDROPHILAE]* Provisional.

Plants as far as known without any terrestrial phase, deep water aquatics with glabrous slimy foliage. Spreading borders to the ochrea always absent.

PERSICARIA FLUITANS (Eaton) Greene, (1904) Leaflets, Vol. I., p. 26.

Polygonum fluitans Eaton in Eaton and Wright, p. 368.

U. S. National Herbarium. 443275, Agnes Chase's (1906) Slough, Dune Park, Ind., IX. 11, 1902. 49140, R. E. Earle's Waukegan, Railroad Ditch. 593946, O. A. Farwell's (352) Belle Isle, IX. 23, 1892. 54741, J. Macoun's Chilliwick Valley, B. C., VIII. 20, 1901. (Duplicate in the N. Y. Bot. Garden Herb.) 257772, Lester Ward's, St. Lawrence River, VIII. 9, 1879. 309481, C. L. Ballard's, Fairlee Lake, Vermont, 1878.

New York Botanical Garden. C. B. Robin's, Picton Co., Grant's Lake, VIII. 25, 1906. E. G. Knight's, Eagle Lake, VII. 30, 1851. N. L. Britton's, Morris Pond, New Jersey, IX. 13, 1887. Jos. Schrenck, Squaw Lake, N. H., VIII, 1882. T. Morong, Little Tupper Lake, Adirondacks, N. Y., IX. 8, 1884. A. G. Grant's, Joe's Pond, W. Danville, Vt., VII. 5, 1894. Wm. Van Sickle's, Morris Pond, Sussex Co., N. Y., VIII. 9, 1894. There is in this last a tendency to form spreading borders to the ochrea!

PERSICARIA CANADENSIS Greene, (1904) Leaflets, Vol. I., p. 28.

N. Y. Bot. Garden Herb. A specimen from the herbarium of P. V. Le Roy, Peekskill, N. Y. Collected in Mass. A. Gray.

The plant as described by Dr. Greene is riparian. The foliage, however, is but slightly scabrous-strigose, and on the whole glabrous. Such a specimen is almost aquatic, and can hardly be interpreted

* This subsection will probably disappear as the members become better known or their terrestrial phases found. It may be that the plants have no terrestrial phase, however, and in that case it will remain, unless another more obvious method of division seem feasible.

as riparian in the sense I have used the word under the description of *P. mesochora* or *P. rigidula* where for want of anything subaquatic in nature, I was forced to designate for these, a riparian plant, that is glabrous or perfectly aquatic below, and quite terrestrial above. *P. ammophila* I have not found to bloom as I have said, in any phase that did not have at least some terrestrial foliage above, though *P. nebrascensis* approached this aquatic habit more. On the basis of these facts I was forced to consider *P. canadensis* and *P. nebrascensis* and especially *P. canadensis* and *P. mesochora* as specifically distinct though their aquatic foliage to the superficial examiner appears indistinguishable in many cases.

Dr. Greene* seems to suspect that *P. canadensis* "may possibly some day be shown to be the riparian state" of *P. fluitans*. I fear that *P. ammophila* may be yet shown to be the terrestrial phase of *P. canadensis*. There is more evidence in my specimens for this suspicion than for Dr. Greene's. As, however, of all the hundreds of specimens I have collected or examined I have found no blooming strictly aquatic form of *P. ammophila*, I must refrain from drawing the conclusion, though the foliage of sterile aquatic of the latter can not be distinguished from that of *P. canadensis* or even *P. fluitans* when perfectly aquatic in nature. Field botanists may yet find plants of *P. ammophila* in which strictly aquatic and riparian and terrestrial forms connected on one shoot. Such a discovery may lead therefore to the recognition of but one of the three, *i. e.*, *P. fluitans* Eaton, the others to be only to be considered as phases of this the oldest name of them all.

The following phases of hitherto known plants have been described by me in the preceding discussions on amphibious smartweeds. Some of these have been described in the preceding article. The types of all phases are in my herbarium except No. 7 which is in the U. S. National Herbarium at Washington.

1. *Persicaria tanaophylla* Nwd. Aquatic, subriparian and terrestrial phases.
2. *Persicaria mesochora* var. *arenicola* Nwd. Aquatic, and terrestrial phases.
3. *Persicaria mesochora* Greene. Terrestrial and riparian phases, also the early summer sterile terrestrial.

* E. L. Greene Leaflets, Vol. I., p. 28.

The plant was hitherto known in the aquatic and subaquatic phases.

4. *Pericaria carictorum* Nwd. Aquatic and Terrestrial, also early summer sterile terrestrial.

5. *Pericaria coccinea* Muhl. Riparian phase. (Known hitherto in the terrestrial and aquatic.)

6. *Pericaria ammophila* Greene. Aquatic and riparian phases.

7. *Pericaria nebrascensis* Greene. Subaquatic or riparian phase.

8. *Pericaria pratensis* Greene. Vestigial aquatic and riparian phases.

9. *Pericaria oregana* Greene. Terrestrial phases.†

10. *Pericaria rigidula* (Sheldon) Greene. Terrestrial phase also riparian.

CONCLUSIONS.

1. The admission of *P. emersa* as commonly understood by botanists, to specific rank on the basis of the "specific" distinctions outlined in our manuals and floras is illogical for those that reduce *P. Hartwrightii* as unworthy of specific rank. Those who suppress one must consistently and for quite similar reasons refuse to accept the other.

2. There is no logical alternative between accepting the Linnaean view of one sole species of amphibious Smartweed on the one hand, and Dr. Greene's view of a number of valid distinct species on the other.

3. On the basis of distinctive specific characters analogously used for well recognized species considered valid in other groups, the method of Dr. Greene is the most logical of all the methods referred to.

4. All the different species of amphibious *Pericarias* have, potentially at least, two or several phases, though one or other may be vestigial or perhaps absent. e. g. *P. fluitans*, (as far as we know.)

5. Polymorphic plants in order to be easily and distinctively recognized in every phase, must be described in our manuals separately for each phase.

6. The system of distinctions as outlined in our manuals of to-day fails to distinguish even the species which they actually recognize by characters which are specifically differential. Other

distinctions must be substituted that properly separate them, if we are to avoid the total confusion that has enveloped and still envelops the knowledge of these plants on the part, not only of our amateur plant students, but most botanists.

7. Two different species of these plants may more or less resemble one another in one or other of their respective phases, and still be considered as distinct, provided they are sufficiently and specifically different in the other corresponding phase or phases; e. g. typical *P. amphibia* and *P. emersa* may look more or less alike in the aquatic, but are totally and unmistakably different in the terrestrial phases of each.

8. The plants may be said to be *normally aquatic* or *normally terrestrial* or *both*, according as they bloom and fruit regularly and respectively in the aquatic, terrestrial or both phases together.

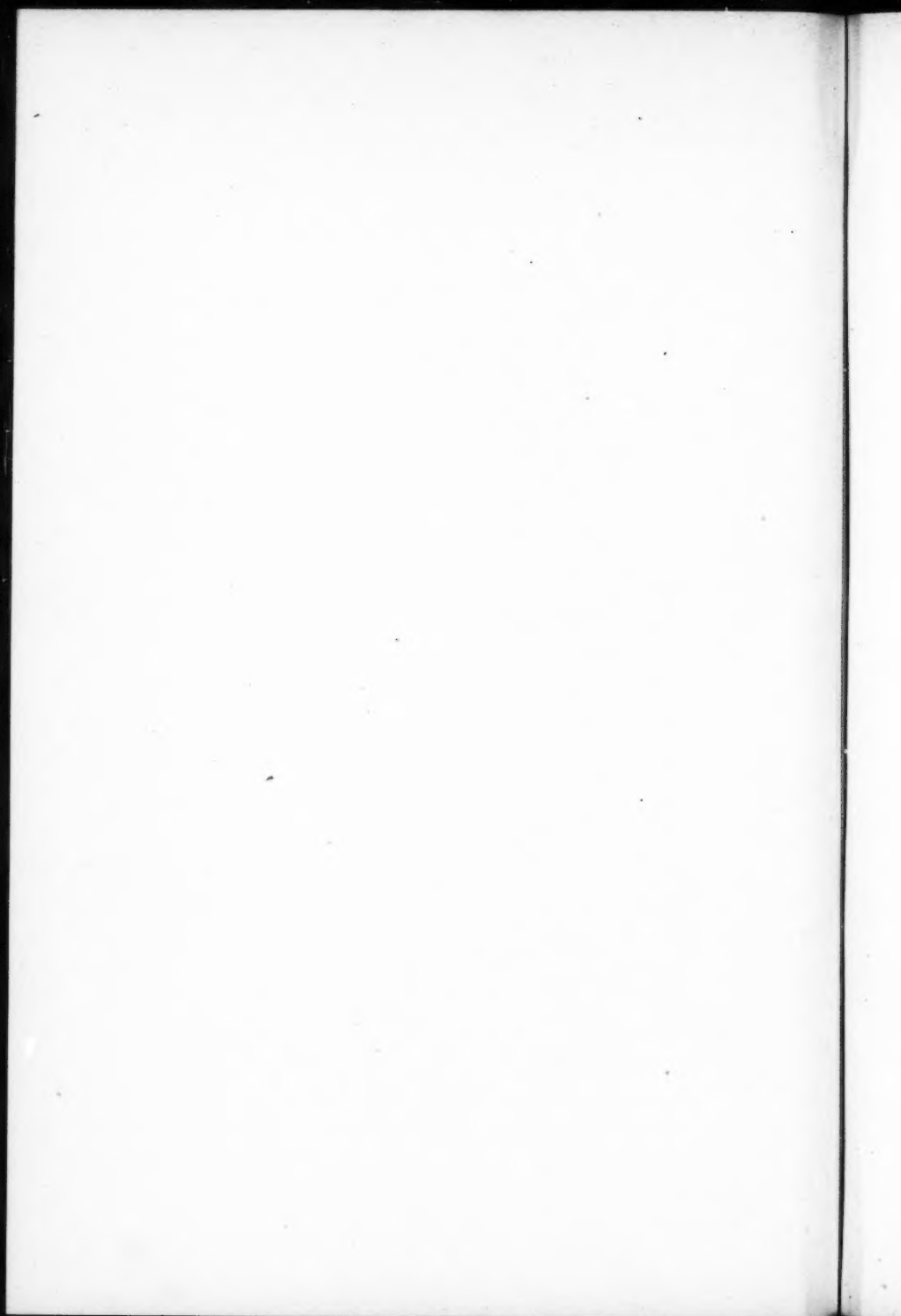
9. Specimens of these plants are to be considered as incomplete, and therefore more or less useless for purposes of identification, that are not present in their several phases. A system of making herbarium specimens, or groups of several or many sheets under one number has been suggested. The various phases are to be lettered in addition to the sheet number. Thus 840a is the aquatic typical, 840k or any last letter used, the terrestrial, and the intermediate letters to represent the transition phases in order of resemblance to one or the other.

10. Absence of any plant in America that perfectly corresponds to the terrestrial phase of the typical European *P. amphibia* points to the fact that *P. amphibia* is not to be looked for on this side of the Atlantic, and that the name therefore should disappear from American manuals of botany. The absence, in Europe, as far as I can find of the *Hartwrightianae* as a group, i. e., plants with spreading herbaceous borders to the ochrea is worthy of note in emphasizing the above statement.

11. A system of classification of the plants as *Emersae*, *Hartwrightianae*, and the provisional *Hydrophilae* in the subgenus *Potamocallis* differs from previous treatment of the subject.

12. Ecological study of these plants in the field can alone solve their relationships to one another, as also their eligibility to specific rank. Seasonal variations of respective phases must be watched with care and perseverance.

Department of Botany,
University of Notre Dame.



Series of Reprints of the Rare Classical Works of Natural History.

No. I.

Rafinesque, C. S. Neogenyton, or Indication of Sixty-six New Genera of Plants of North America, 1825.

Price, 25c per Copy

Postage 2 cents extra.

Exact photographic reproduction of this important text. Good as the original for practical purposes. This pamphlet contains a number of the Rafinesquian Genera now commonly recognized as valid by botanists generally, as also others that are not, but will sooner or later receive recognition.

No student of botany should be without this valuable work now so easily available.

Series of Reprints of the Rare Classical Works of Natural History.

No. 2.

Rafinesque, C. S. Monographie des Coquilles Bivalves et Fluviatiles de la Riviere Ohio. Remarques sur les Rapports Naturels des Genres *Viscum*, *Samolus* et *Viburnum*. A Bruxelles, De l'Imprimerie de Weissenbrugh pere, Rue du Musee, No. 1057 (1820). [Part of *Annals of Nature*,] pp. 17 to 60 (41 pages).

Price, \$1.50 per Copy

Postage 2 cents extra.

Probably the most sought for classic on American Conchology, and as rare as it is valuable. We have not seen an original copy for sale! This reprint is as good as the original for the working conchologist. The title page and 2nd page and the three plates are fac-simile reproductions and the text is a word-for-word reprint with the exact paging of the original. A number of new genera and species were published in this first important monograph, and it is therefore indispensable to the practical student of American shells.

